The impact of schizophrenia spectrum disorder, bipolar disorder and borderline personality disorder on radiotherapy treatment and overall survival in cancer patients: A matched pair analysis

Max Peters [a,*], Hajo W. Boersma [a], Peter S.N. van Rossum [a,b], Jasper van Oort [c], Wiepke Cahn [d,e], Joost J.C. Verhoeff [a]

[a] *Department of Radiation Oncology, University Medical Centre Utrecht, Utrecht, The Netherlands*
[b] *Department of Radiation Oncology, Amsterdam UMC, location VUmc, Amsterdam, The Netherlands*
[c] *Department of Psychiatry, Radboud University Medical Centre, Nijmegen, The Netherlands*
[d] *Department of Psychiatry, University Medical Centre Utrecht, UMC Utrecht Brain Centre, Utrecht University, Utrecht, The Netherlands*
[e] *Altrecht Science, Altrecht Mental Health Care, Utrecht, The Netherlands*

ARTICLE INFO

ABSTRACT

Introduction: The effect of a psychiatric disorder (PD) on the choice of radiotherapy regimens and subsequent cancer control outcomes is largely unknown. In this study, we evaluated differences in radiotherapy regimens and overall survival (OS) between cancer patients with a PD in comparison with a control population of patients without a PD.

Methods: Referred patients with a PD (i.e. schizophrenia spectrum disorder, bipolar disorder or borderline personality disorder) were included through a text-based search of the electronic patient database of all the patients that received radiotherapy between 2015 and 2019 at a single centre. Each patient was matched to a patient without a PD. Matching was based on cancer type, staging, performance score (WHO/KPS), non-radiotherapeutic cancer treatment, gender and age. Outcomes were the amount of fractions received, total dose, and OS.

Results: 88 patients with PD were identified; 44 patients with schizophrenia spectrum disorder, 34 with bipolar disorder, and 10 with borderline personality disorder. Matched patients without a PD showed similar baseline characteristics. No statistically significant difference was observed regarding the number of fractions with a median of 16 (interquartile range [IQR] 3–23) versus 16 (IQR 3–25), respectively (p = 0.47). Additionally, no difference in total dose was found. Kaplan-Meier curves showed a statistically significant difference in OS between the patients with a PD versus those without a PD, with 3-year OS rates of 47 % versus 61 %, respectively (hazard ratio 1.57, 95 % confidence interval 1.05–2.35, p = 0.03). No clear differences in causes of death were observed.

Conclusion: Cancer patients referred for radiotherapy with schizophrenia spectrum disorder, bipolar disorder or borderline personality disorder receive similar radiotherapy schedules for a variety of tumour types but attain worse survival.

Introduction

Severe mental illness including schizophrenia spectrum disorder, bipolar disorder and borderline personality disorder have lifetime prevalences of 0.5 %, 1.2 %, 1 % respectively [1,2] and are associated with large influences on QoL and excessive mortality [3–5]. In the oncology setting, patients with mental illness, in particular those with severe mental illness, have several disadvantages compared to patients without a mental illness. They can present with more advanced disease compared to the general population and are underrepresented in clinical trials. Also, mortality can be significantly higher due to less frequent adoption of specialised care including radiotherapy, surgery and systemic treatments [6–9] and a higher chance of treatment delays [10]. Moreover, a relationship between the severity of the psychiatric disorder (PD) prior to cancer treatment and mortality is observed [11]. When treated with anticancer therapies, increased risks of postoperative

complications [12,13] and readmissions [14–16] have been described for patients with severe mental illness.

Only little evidence is available on the effect of having a (severe) mental illness during the course of radiotherapy and its impact on outcomes. In a previous study, a group of 33 head and neck cancer patients with a variety of psychiatric diagnoses were found to be more likely to miss > 5 days of treatment (48 % versus 13 % in patients without a PD) [17], with an unreported but likely negative impact on prognosis. Another study in head and neck cancer found that levels of experienced distress and depressive symptoms were associated with decreased radiotherapy compliance and worse survival [18]. In the scarce literature on breast cancer patients, the compliance of patients with schizophrenia spectrum disorder is contradictive [19–21].

The aim of this study was to assess the impact of schizophrenia spectrum disorder, bipolar disorder, and borderline personality disorder on the choice of radiotherapy regimens and related survival outcomes for several tumour types.

Materials and methods

Ethical considerations

Utilisation of routine care data in the electronic patient database (EPD) is in accordance with the guidelines of the Institutional Review Board. The local Medical Ethics Committee allowed the use of patient data for scientific research after adequate de-identification and the need for written informed consent was waived (ref. no. 20/318). At our institution, patients are informed at the time of first consultation that their data may be used for scientific research after de-identification. To comply with data safety standard we anonymised all EPD entries before analysis. This study was conducted in accordance with the Declaration of Helsinki.

Study population, data collection, and design

For this retrospective observational matched-pair cohort study, we performed a text-based search in the EPD of the radiotherapy department of a single tertiary referral centre of all patients who received radiotherapy between 2015 and 2019. A flow-chart of the patient selection process is presented in Supplementary Fig. 1. The search included the words bipola*, schizophren*, and borderlin*. Patients > 18 years who received radiotherapy and had one or more of these psychiatric disorders according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-)IV in their medical history from their primary care physician were included. We extracted the following additional information: (i) gender, (ii) age, (iii) cancer type and location, (iv) cancer staging, (v) World Health Organization Performance Status (WHO-PS), (vi) Karnofsky Performance Status (KPS), (vii) cancer treatment (including radiotherapy regimen and dose in Gy), (viii) curative versus palliative intent of treatment, (ix) start and end date of radiotherapy, and (x) date of death.

If no WHO-PS or KPS was mentioned, an estimation was done by two independent researchers based on available clinical data. Patients were divided in 2 groups (WHO-PS 0–2 or 3–4 and KPS 100–60 or 50–40). Physical radiotherapy doses were converted to biologically equivalent doses in 2 Gy fractions (EQD2) using an alpha/beta of 3 and 10 for late toxicity and tumour control/acute toxicity, respectively. Intent of treatment was determined by the primary researcher and verified by a radiation oncologist. Days of survival from the start of radiotherapy were calculated to the date of death or last follow-up (censored on the 10th of August 2022) through a formal vital status check through the national municipalities database.

During the study period, a psychiatrist was not formally involved in the oncological treatment planning.

Matching

A control cohort was constructed manually using pairwise matching from the remaining pool of patients without a PD in their medical history who received radiotherapy between 2015 and 2019 in our centre. Patients were matched using the following criteria in order of priority: (i) cancer type and stage, (ii) WHO-PS or KPS, (iii) gender, (iv) age, and (v) non-radiotherapeutic cancer treatment received before and after radiotherapy. All patients with the same cancer type and staging according to the automated data extraction were selected and sorted by age. Patients were manually checked for being a possible match by groups of 5 starting at the most comparable age of the patient with a psychiatric disorder and increasingly deviating from that age if no optimal match was found.

TNM-staging (8th edition) was used for breast, gastrointestinal, head and neck, lung and urologic cancer, FIGO staging for gynaecologic cancer, and WHO-grade for brain tumours. Pathologic cancer staging was used if available; otherwise clinical staging was used. Breast tumours were also matched based on the absence or presence of hormone sensitivity and Her2Neu status of the tumour, when available. Lastly, when possible, patients were matched for receiving the same non-radiotherapeutic treatments before and after radiotherapy, i.e. chemotherapy, hormone therapy (neoadjuvant and adjuvant), and surgery, including (ir)radicality.

Statistical analysis

Baseline characteristics were depicted as median with corresponding interquartile ranges (IQR) or mean and standard deviations (SD) for continuous variables depending on the normality of the distribution and frequencies with percentages for categorical variables. Differences between the patients with PD and patients without a PD were compared with the Wilcoxon signed-rank test for biologically equivalent radiotherapy dose and the amount of fractions received.

Standardised mean differences (SMDs) were calculated for baseline characteristics to assess the quality of the matching procedure. SMDs < 0.10 indicate negligible differences in baseline covariate distribution [22,23]. Due to the smaller sample size, we accepted SMD differences up to 0.25. We subsequently corrected for remaining baseline imbalances indicated by SMD > 0.10 in a multivariable Cox proportional hazards model [24].

The primary outcome was the amount of fractions received and biologically equivalent dose in 2 Gy fractions (EQD2) to assess if radiotherapy regimens were similar between groups. Secondary, survival analysis was performed using Kaplan-Meier curves and hazard ratios (HRs) were calculated using Cox proportional hazards regression models. The proportional hazards assumption was checked using Schoenfeld residuals. Results were considered significant if p < 0.05. Analyses of the data were performed with IBM SPSS Statistics 28 and R studio version 4.1.2 (The R Foundation for Statistical Computing, available at https://www.rstudio.com/products/rstudio/download/).

Results

Baseline

The screening identified 88 patients with either bipolar disorder (n = 34, 38.6 %), schizophrenia spectrum disorder (n = 44, 50 %) or borderline personality disorder (n = 10, 11.4 %). A matching control group of 88 patients without a PD was selected. Mean age was 61.0 (SD 10.6) versus 63.6 (SD 11.3) years for patients with versus without a PD (SMD 0.24). A total of 54 (61 %) versus 59 (67 %) patients were female (SMD 0.12) and WHO-PS was 3–4 and KPS 0–50 in 10 (11.4 %) versus 7 (8 %), respectively (SMD 0.12). Other characteristics had SMD < 0.10 and details are provided in Table 1. Both the cohort of patients with versus without a PD had 27 patients with breast cancer (30.7 %), 16 lung

Table 1
Baseline characteristics of the study populations.

Characteristic	Patients with a PD	Patients without a PD	SMD
N (%)	88 (100)	88 (100)	NA
Women	54 (61)	59 (67)	0.12
Mean age (SD)	61.0 (10.6)	63.6 (11.3)	0.24
WHO-PS 0–2/KPS 60–100	78 (88.6)	81 (92)	0.12
WHO-PS 3–4/ KPS ≤ 50	10 (11.4)	7 (8)	
Follow-up	32.3 (9.2–53.8)	41.3 (12.7–65.1)	NA
Died during follow-up	57 (64.8)	42 (47.7)	NA
Disease progression	37 (64.9)	39 (92.9)	
Missing	17 (29.8)	2 (4.8)	
Other causes	3 (5.3): multimorbidity pneumonia, subarachnoid haemorrhage)	1 (2.4): heart failure	
Psychiatric medical history			
Bipolar disorder	34 (38.6)	0 (0.0)	NA
Schizophrenia spectrum disorder	44 (50)	0 (0.0)	NA
Borderline personality disorder	10 (11.4)	0 (0.0)	NA
Radiotherapy treatment details			
Amount of fractions, median [IQR]	16 [3–23]	16 [3–25]	0.05
EQD2 (Gy), $\alpha/\beta = 3$, median [IQR]	48 [35–63]	48 [35–63]	0.02
EQD2 (Gy), $\alpha/\beta = 10$, median [IQR]	45 [24–60]	45 [24–60]	0.02
Curative treatment intent	57 (64.8)	56 (63.6)	0.02
Oncologic details			
Brain	4 (4.5)	4 (4.5)	<0.001
Breast	27 (30.7)	27 (30.7)	
ER negative +/-	10/3	11/5	
PR negative +/-	6/7	9/7	
Her2Neu +/-	0/13	4/12	
Gastrointestinal	14 (15.9)	14 (15.9)	
Gynaecologic	6 (6.8)	6 (6.8)	
Head and neck	10 (11.4)	10 (11.4)	
Lung	16 (18.2)	16 (18.2)	
Urologic	5 (5.7)	5 (5.7)	
Other	6 (6.8)	6 (6.8)	
R0/R1/Rx surgery	10/7/19	10/3/19	0.05
Additional treatments			0.15
None	36	36	
Chemoradiation	11	13	
Chemotherapy ([neo-]adjuvant or not known)	7	12	
Hormone therapy	5	5	

Abbreviations: N = number of patients; PD = psychiatric disorder; SMD = standardised mean difference; SD = standard deviation; WHO-PS = World Health Organisation Performance Score; KPS = Karnofsky Performance Score; IQR = interquartile range; EQD2 = equivalent dose in 2 Gy fractions; ER = estrogen receptor, PR = progesterone receptor; Her2 = human epidermal growth factor receptor 2. -/+ denotes amount of patients with known receptor status; R0/R1/Rx = radical/microscopically irradical/unknown radicality.

cancer (18.2 %), 14 gastrointestinal cancer (15.9 %), 10 head and neck cancer (11.4 %), 6 gynaecologic cancer (6.8 %), 4 brain tumours (4.5 %), 5 urologic cancers (5.7 %), and 6 other types of cancer (6.8 %). Median follow-up from completion of radiotherapy was 32.3 months (IQR 9.2–53.8) and 41.3 months (IQR 12.7–65.1) for patients with versus without a PD, respectively (p = 0.11). See details regarding staging in Supplementary Table S1.

Primary outcome

No statistically significant difference was observed regarding the number of fractions with a median of 16 fractions (IQR 3–23) versus 16 fractions (IQR 3–25) for patients with versus without a PD, respectively (p = 0.47). There was also no difference in EQD2 with a median of 48 Gy (IQR 35–63 Gy) versus 48 Gy (IQR 35–63 Gy) for late toxicity and 45 Gy (IQR 24–60 Gy) versus 45 Gy (IQR 24–60 Gy) for tumour control/acute toxicity, respectively (p = 0.18 and 0.77).

Secondary outcomes

At 1, 3 and 5 years, overall survival (OS) for both cohorts together was 73 % (95 % confidence interval [CI] 66–80 %), 54 % (95 %-CI 47–62 %) and 46 % (95 %-CI 39–55 %) (Fig. 1a). Statistically significant differences in OS were observed between patients with versus without a PD. At 1, 3 and 5 years, OS rates were 68 % (95 %-CI 59–79 %), 47 % (95 %-CI 37–58 %), and 37 % (95 %-CI 27–50 %) versus 77 % (95 %-CI 69–87 %), 61 % (95 %-CI 52–72 %) and 56 % (95 %-CI 46–67 %), respectively (p = 0.03; Fig. 1b).

Based on tumour type, there were expected survival differences between the large tumour sites (breast, GI and lung cancers): 2-year OS of 87 % (95 %-CI 79–97), 57 % (95 %-CI 42–79 %) and 34 % (95 %-CI 21–56 %), respectively (p < 0.0001; Fig. 1c).

Assessing separate tumour sites, some differences in OS were observed between patients with PD and without a PD that did not reach statistical significance (Supplementary Figure S2). Due to smaller sample sizes in subgroups, 1 and 3 year estimates are provided. For breast cancer, 3-year OS was 78 % (95 %-CI 64–95 %) compared to 89 % (95 %-CI 78–100 %) (p = 0.11). For lung cancer, 1-year OS estimates were 38 % (95 %-CI 20–71 %) for both groups (p = 0.31). For GI cancers, 1-year OS was 64 % (95 %-CI 44–95 %) for both groups (p = 0.61). For head and neck cancer patients, 1-year OS was 60 % (95 %-CI 36–100 %) versus 80 % (59–100 %) (p = 0.77).

The Cox model showed a univariable hazard ratio (HR) for patients with versus without a PD on OS of 1.57 (95 %-CI 1.05–2.35; p = 0.03). Corrected for age, which had SMD of 0.24, the HR was 1.66 (95 %-CI 1.10–2.48; p = 0.01). Corrected for age, WHO-PS/KPS and gender (all SMD > 0.10), the HR was 1.60 (95 %-CI 1.06–2.41; p = 0.02). Correction for additional treatments resulted in exclusion of 31 % of cases with a decrease in power and a HR of 1.91 (95 %-CI 1.20–3.04; p = 0.007). No violations of the proportional hazards assumption were observed. Other univariable results are presented in Table 2.

The mortality distribution was mostly disease progression: n = 37 (64.9 %) in patients with a PD and n = 39 (92.9 %) of all deaths in patients without a PD. In 17 (29.8 %) patients with a PD information about the cause of death was missing. Several cases were related to other causes of death. In 3 patients with a PD causes of death were multimorbidity (most likely liver cirrhosis), pneumonia and subarachnoid haemorrhage. And 1 patient without a PD died of heart failure.

Discussion

When comparing cancer patients with and without a PD that were referred to a tertiary centre for radiotherapy, we found no statistically significant difference in the average number of radiotherapy fractions received or in the overall radiotherapy dose. This suggests that cancer patients with versus without a PD do not receive different radiotherapy
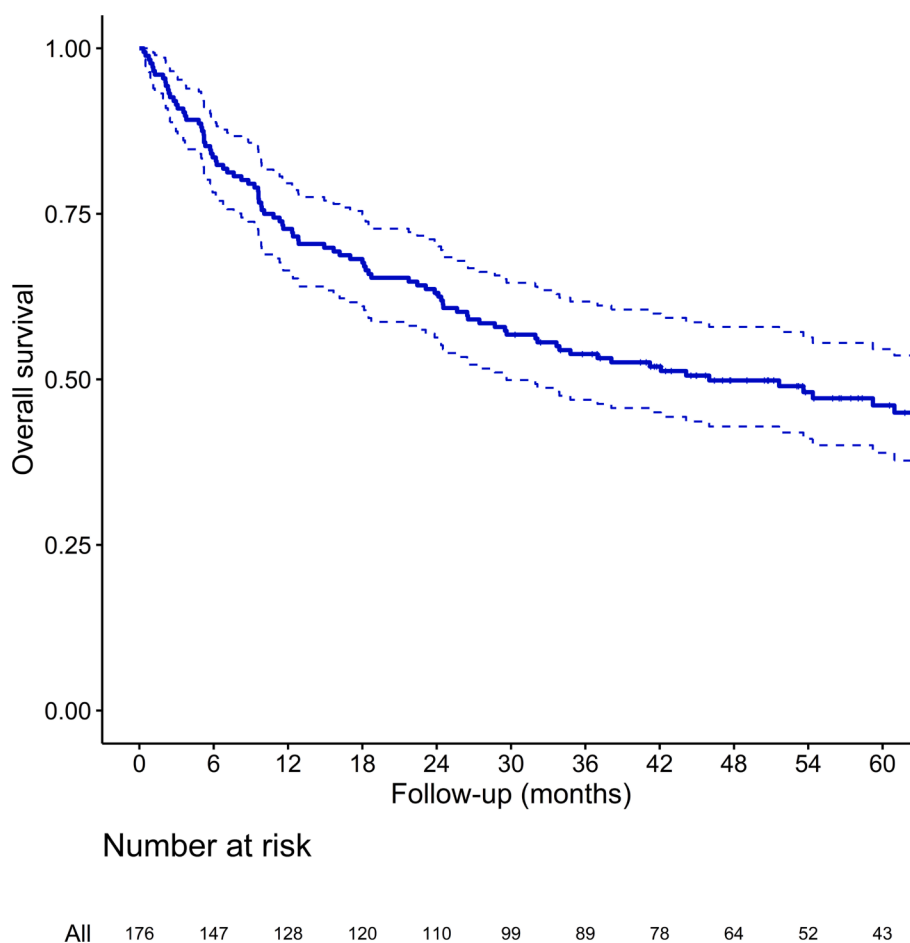
Fig. 1. . a-c: Overall survival in the entire cohort (a), subdivided by patients with apsychiatric diagnosis (PD) and without a PD (b), and for several cancer types (c). GI = gastro-intestinal.

regimens and radiotherapy adherence was similar between the two groups. However, we did find a significant difference in OS when comparing referred patients with versus without a PD without indications that this difference originated in specific tumour subgroups. This difference in survival was retained when corrected for variables which were slightly unbalanced at baseline.

There has not been a study that compares radiotherapeutic treatments between matched pairs of patients with and without a PD for multiple tumour subgroups and little is known in general about the influence of psychiatric disorders on radiotherapy adherence.

Unfortunately, not enough data was available to potentially explain this survival difference, such as somatic comorbidities, living environment, smoking behavior and other lifestyle factors which can have a negative influence on survival and radiotherapy effectiveness, especially in the case of active smoking during treatment [25]. In patients with severe mental illnesses, increased cardiovascular morbidity and mortality is observed due to more sedentary lifestyle, increased smoking behavior and diet in these patients [26,27]. Furthermore, suicide rates in the analysed psychiatric diagnoses is significant (11–19 % for bipolar disorder, 4–13 % for schizophrenia spectrum disorder and 3–6 % for borderline personality disorder)[28–30]. Interestingly, we found no suicide-related mortality, potentially related to the majority of mortality in this cohort being related to disease progression.

In prostate cancer patients, Safdieh et al. reported no differences in biochemical control, overall survival, prostate cancer-specific survival, distant metastasis-free survival or toxicity between patients with or without PD treated with radiotherapy for prostate cancer [31]. In this

study, posttraumatic stress disorder (n = 51), depression (n = 29), schizophrenia (n = 13), bipolar disorder (n = 5), and/or generalised anxiety disorder (n = 2) were analysed as one group, thereby hampering a good comparison with our current domain of patients. Furthermore, no details regarding radiation treatment completion or subsequent treatments which could significantly impact prostate cancer specific and overall survival are provided.

In breast cancer patients, Abdullah et al. concluded that patients with schizophrenia did not understand the nature of their breast cancer well and that these patients did not comply with recommended standard therapies such as adjuvant radiation therapy after breast-preserving surgery, which was offered to only 22/40 (63 %) and refused by 5/22 (23 %) [19]. Patients had frequent comorbidities though (such as chronic obstructive pulmonary disease [36 %]), potentially influencing high toxicity rates observed and the choice to abstain from adjuvant radiation treatment. No data on tumour control and no matched control group are described in this study. The population consisted of patients with a high psychiatric disease burden, as visible in the 52 % medication refusal rate and high suicidal and homicidal ideation rates (38 % and 11 %, respectively). Previously, the researchers had observed that other treatments in the care for breast cancer patients with schizophrenia were often not feasible because of refusal or delay of treatment by the patients [20]. However, a previous study by Sharma et al. concluded that schizophrenia did not affect treatment delivery or outcomes for patients with breast cancer [21]. All 37 patients were registered as receiving antipsychotic treatment at the time of treatment of their breast cancer, potentially indicating an influence of disease severity on treatment
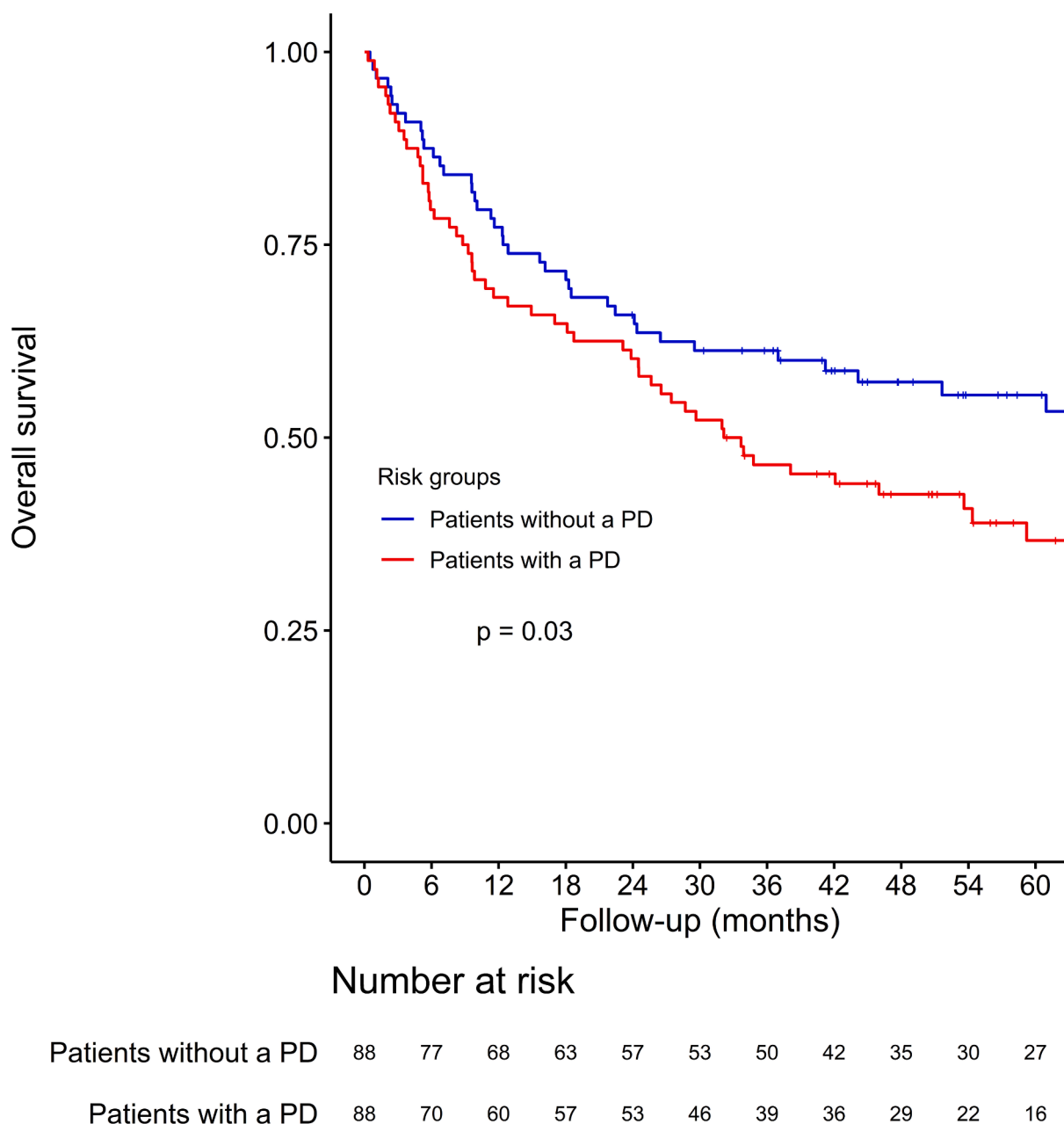
Number at risk

	0	6	12	18	24	30	36	42	48	54	60
Patients without a PD	88	77	68	63	57	53	50	42	35	30	27
Patients with a PD	88	70	60	57	53	46	39	36	29	22	16

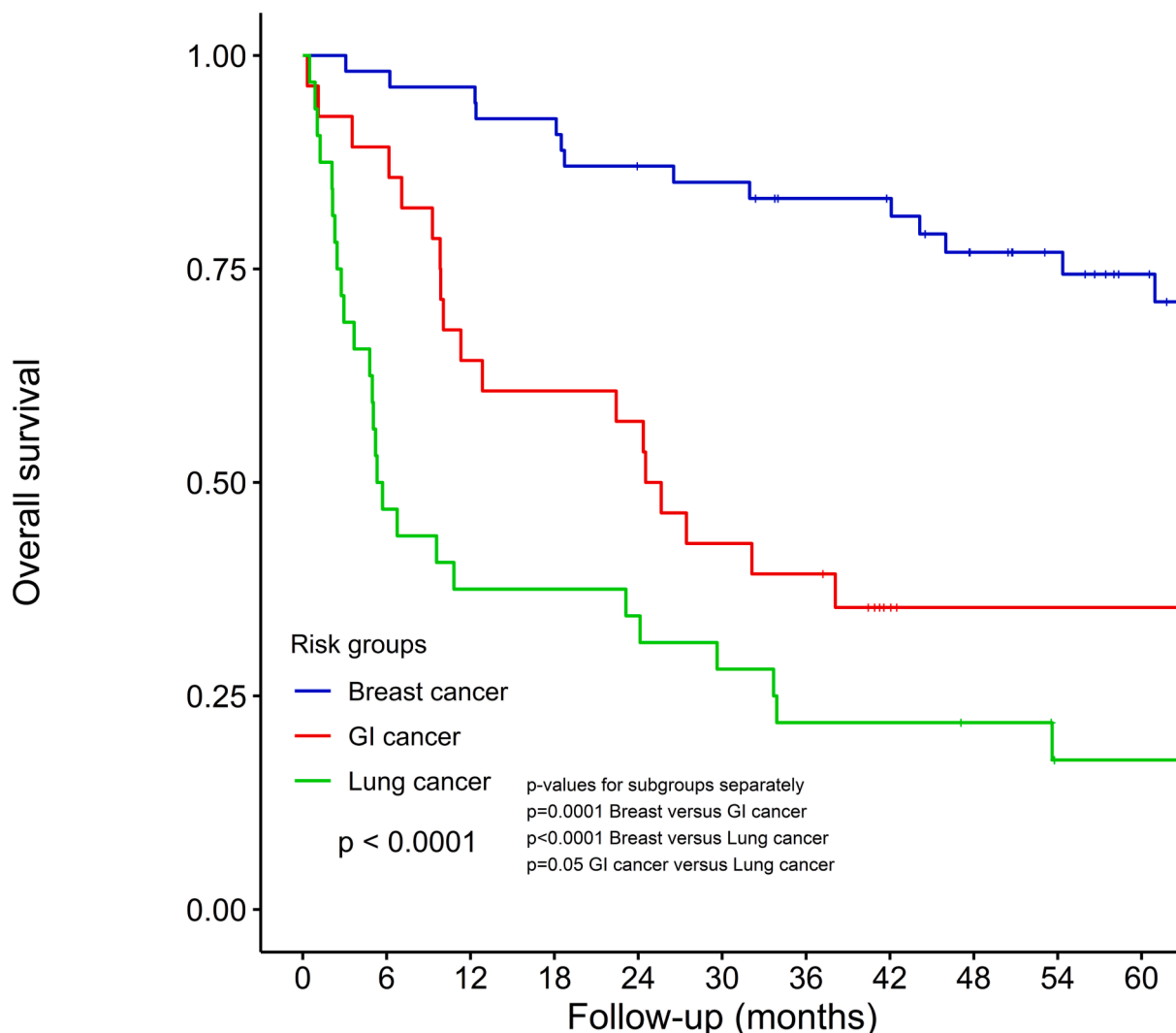**Fig. 1.** (*continued*).

acceptation and adherence.

Lastly, a group of 33 patients with head and neck cancer and a variety of psychiatric diagnoses (79 % mood disorders) were observed to miss > 5 days of treatment in 48 % of cases compared to 13 % of patients without a psychiatric diagnosis, with a potentially negative impact on prognosis. Patients were noted to undergo psychotherapy in only a minority of cases (15 %) [17].

There are inherent limitations to this study. First, the population is a selected sample of referred patients, potentially representing a more favourable clinical and therefore prognostic group.

The sample size (as a whole and especially in subgroups) and retrospective observational character of the study do not allow correction for many potential confounding factors. We have tried to overcome this limitation by meticulous manual matching, leading to small baseline imbalances. Correcting for these small imbalances did not alter the conclusions, but we cannot exclude any residual confounding, such as differences in important prognostic lifestyle factors mentioned above.

Furthermore, the smaller sample sizes per tumour type did not allow an adequate analysis of where the overall survival difference predominantly originates.

We have only included patients with schizophrenia spectrum disorder, bipolar disorder, and borderline personality disorder, thereby limiting the domain of patients to which the results of this study are applicable. Many studies in literature have groups of people with depression included, which is shown to have a major influence on quality of life (QoL) in all demographic groups of the population [4]. This could potentially also influence compliance with radiation treatment, as has been described to be the case in other areas of cancer treatment [12,14,15,32]. Contrary to this, the specific psychiatric diagnoses studied here are known to carry some of the largest influences on QoL and excessive mortality with loss of life-years in psychiatry [3–5]. Therefore, we feel the specific selection does provide us with insight into the quality of cancer treatment for the specific malignancies presented in our study. And potentially that this quality in cancer

Number at risk										
Breast cancer	54	53	52	50	46	45	41	40	34	30	24
GI cancer	28	25	18	17	16	12	11	5	3	3	3
Lung cancer	32	15	12	12	11	9	7	7	6	3	3

Fig. 1. (*continued*).

treatment and survival difference can be extrapolated to other psychiatric diagnoses as well.

Lastly, we didn't collect data on the severity of these disorders in individual patients or psychiatric treatment adherence, for which correction probably would not have been possible due to the small sample size. We observed no difference in received radiotherapy between the cohorts, potentially indicating adequate psychiatric care and compliance during treatment in this population.

Survival of radiotherapy for referred cancer patients with a registered PD is decreased compared with the population without a PD in a tertiary radiotherapy centre. To answer the pivotal question if quality of oncologic care is comparable for cancer patients with and without a PD, data from a large national database will be investigated in a further study. Furthermore, with this we hope to attain more insight into psychiatric care during oncological treatment.

Conclusion

Patients with cancer referred to a tertiary radiotherapy centre in the Netherlands with bipolar disorder, schizophrenia spectrum disorder or borderline personality disorder did not receive different (e.g. suboptimal) radiotherapy regimens for a variety of cancers compared with matched patients without a PD. However, the patients with a PD did have a statistically significant worse OS, indicating necessary vigilance for this vulnerable population and more research into potentially modifiable factors during oncologic treatment.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 2
Univariable Cox regression analysis for mortality.

Variable	HR	Lower 95 %-CI	Upper 95 %-CI	p-value
Patients with a PD vs without a PD	1.57	1.05	2.35	0.03
Female (vs male)	0.35	0.23	0.52	<0.01
Age (per year increase)	1.02	1.001	1.04	0.04
EQD2 (per Gy increase)	0.99	0.99	1.0003	0.06
EQD2 (per 10 Gy increase)	0.94	0.89	1.003	0.06
Brain cancer (vs lung)	0.61	0.26	1.42	0.25
Breast cancer (vs lung)	0.17	0.09	0.31	<0.01
GI cancer (vs lung)	0.56	0.31	1.03	0.06
Gynaecological cancer (vs lung)	0.25	0.10	0.66	<0.01
Head and neck cancer (vs lung)	0.5	0.25	0.99	0.05
Urologic cancer (vs lung)	0.92	0.41	2.04	0.84
Other cancer (vs lung)	0.22	0.08	0.57	<0.01
WHO-PS/KPS 3–4/0–50 (vs 0–2/ 60–100)	5.59	3.25	9.62	<0.01
Amount of fractions (per fraction increase)	0.96	0.94	0.98	<0.01
Curative (vs palliative)	0.17	0.11	0.25	<0.01
Chemoradiation (versus no additional treatment)	0.55	0.32	0.96	0.04
Chemotherapy (versus no additional treatment)	0.18	0.07	0.45	<0.01
Hormone therapy (versus no additional treatment)	0.27	0.08	0.85	0.03
R1 surgery (versus R0 surgery)	1.22	0.31	4.74	0.77
Rx surgery (versus R0 surgery)	1.56	0.61	3.96	0.35

Abbreviations: HR = hazard ratio; CI = confidence interval; PD = psychiatric disorder; EQD2 = equivalent dose in 2 Gy fractions; Gy = Gray, GI = gastro-intestinal, WHO-PS = World Health Organisation Performance Score; KPS = Karnofsky Performance Score.
NB: n = 55 (31 %) missing for additional treatment and n = 98 missing (56 %) for radicality of surgery.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctro.2023.100618.

References

[1] de Graaf R, ten Have M, van Gool C, van Dorsselaer S. Prevalence of mental disorders and trends from 1996 to 2009. Results from the Netherlands Mental Health Survey and Incidence Study-2. Soc Psychiatry Psychiatr Epidemiol 2012;47 (2):203–13.
[2] ten Have M, Verheul R, Kaasenbrood Ad, van Dorsselaer S, Tuithof M, Kleinjan M, et al. Prevalence rates of borderline personality disorder symptoms: a study based on the Netherlands Mental Health Survey and Incidence Study-2. BMC Psychiatry 2016;16(1).
[3] Walker ER, McGee RE, Druss BG. Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. JAMA Psychiat 2015; 72(4):334–41.
[4] Collaborators GBDMD. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. Psychiatry 2022;9(2):137–50.
[5] Kjaer JNR, Biskin R, Vestergaard C, Munk JRP. All-Cause Mortality of Hospital-Treated Borderline Personality Disorder: A Nationwide Cohort Study. J Pers Disord 2020;34(6):723–35.
[6] Kisely S, Sadek J, MacKenzie A, Lawrence D, Campbell LA. Excess cancer mortality in psychiatric patients. Can J Psychiatry 2008;53(11):753–61.
[7] Kisely S, Crowe E, Lawrence D. Cancer-related mortality in people with mental illness. JAMA Psychiat 2013;70(2):209–17.
[8] Kaerlev L, Iachina M, Trosko O, Qvist N, Ljungdalh PM, Norgard BM. Colon cancer patients with a serious psychiatric disorder present with a more advanced cancer stage and receive less adjuvant chemotherapy - A Nationwide Danish Cohort Study. BMC Cancer 2018;18(1):1050.
[9] Batty GD, Whitley E, Gale CR, Osborn D, Tynelius P, Rasmussen F. Impact of mental health problems on case fatality in male cancer patients. Br J Cancer 2012; 106(11):1842–5.
[10] Iglay K, Santorelli ML, Hirshfield KM, Williams JM, Rhoads GG, Lin Y, et al. Diagnosis and treatment delays among elderly breast cancer patients with pre-existing mental illness. Breast Cancer Res Treat 2017;166(1):267–75.
[11] Klaassen Z, Wallis CJD, Goldberg H, Chandrasekar T, Sayyid RK, Williams SB, et al. The impact of psychiatric utilisation prior to cancer diagnosis on survival of solid organ malignancies. Br J Cancer 2019;120(8):840–7.
[12] Paredes AZ, Hyer JM, Diaz A, Tsilimigras DI, Pawlik TM. The Impact of Mental Illness on Postoperative Outcomes Among Medicare Beneficiaries: A Missed Opportunity to Help Surgical Patients? Ann Surg 2020;272(3):419–25.
[13] Bailey EA, Wirtalla C, Sharoky CE, Kelz RR. Disparities in operative outcomes in patients with comorbid mental illness. Surgery 2018;163(4):667–71.
[14] Ratcliff CG, Massarweh NN, Sansgiry S, Dindo L, Cully JA. Impact of Psychiatric Diagnoses and Treatment on Postoperative Outcomes Among Patients Undergoing Surgery for Colorectal Cancer. Psychiatr Serv 2021;72(4):391–8.
[15] Jarvis CA, Bonney PA, Yuan E, Ding Li, Chow F, Kim AW, et al. Comorbid depression in surgical cancer patients associated with non-routine discharge and readmission. Surg Oncol 2021;37:101533.
[16] Olive JK, Zhou N, Mitchell KG, Corsini EM, Hofstetter WL, Mehran RJ, et al. Impact of Psychiatric Comorbidities on Surgical Outcomes for Non-Small Cell Lung Cancer. Ann Thorac Surg 2022;113(3):1008–14.
[17] Sreeraman R, Vijayakumar S, Chen AM. Correlation of radiation treatment interruptions with psychiatric disease and performance status in head and neck cancer patients. Support Care Cancer 2013;21(12):3301–6.
[18] Chen AM, Hsu S, Felix C, Garst J, Yoshizaki T. Effect of psychosocial distress on outcome for head and neck cancer patients undergoing radiation. Laryngoscope 2018;128(3):641–5.
[19] Abdullah KN, Janardhan R, Hwang M, Williams CD, Farasatpour M, Margenthaler JA, et al. Adjuvant radiation therapy for breast cancer in patients with schizophrenia. Am J Surg 2015;209(2):378–84.
[20] Farasatpour M, Janardhan R, Williams CD, Margenthaler JA, Virgo KS, Johnson FE. Breast cancer in patients with schizophrenia. Am J Surg 2013;206(5):798–804.
[21] Sharma A, Ngan S, Nandoskar A, Lowdell C, Lewis JS, Hogben K, et al. Schizophrenia does not adversely affect the treatment of women with breast cancer: a cohort study. Breast 2010;19(5):410–2.
[22] Yao XI, Wang X, Speicher PJ, Hwang ES, Cheng P, Harpole DH, et al. Reporting and Guidelines in Propensity Score Analysis: A Systematic Review of Cancer and Cancer Surgical Studies. J Natl Cancer Inst 2017;109(8).
[23] Austin PC. An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. Multivariate Behav Res 2011;46(3): 399–424.
[24] Nguyen TL, Collins GS, Spence J, Daures JP, Devereaux PJ, Landais P, et al. Double-adjustment in propensity score matching analysis: choosing a threshold for considering residual imbalance. BMC Med Res Methodol 2017;17(1):78.
[25] Perdyan A, Jassem J. Impact of Tobacco Smoking on Outcomes of Radiotherapy: A Narrative Review. Curr Oncol 2022;29(4):2284–300.
[26] Correll CU, Solmi M, Veronese N, Bortolato B, Rosson S, Santonastaso P, et al. Prevalence, incidence and mortality from cardiovascular disease in patients with pooled and specific severe mental illness: a large-scale meta-analysis of 3,211,768 patients and 113,383,368 controls. World Psychiatry 2017;16(2):163–80.
[27] Vancampfort D, Firth J, Schuch FB, Rosenbaum S, Mugisha J, Hallgren M, et al. Sedentary behavior and physical activity levels in people with schizophrenia, bipolar disorder and major depressive disorder: a global systematic review and meta-analysis. World Psychiatry 2017;16(3):308–15.
[28] Costa LdS, Alencar ÁP, Neto PJN, Santos MdSVD, da Silva CGL, Pinheiro SdFL, et al. Risk factors for suicide in bipolar disorder: a systematic review. J Affect Disord 2015;170:237–54.
[29] Paris J. Suicidality in Borderline Personality Disorder. Medicina (Kaunas) 2019;55 (6):223.
[30] Simms J, McCormack V, Anderson R, Mulholland C. Correlates of self-harm behaviour in acutely ill patients with schizophrenia. Psychol Psychother 2007;80 (Pt 1):39–49.
[31] Safdieh JJ, Schwartz D, Rineer J, Weiner JP, Wong A, Schreiber D. Does the Presence of a Major Psychiatric Disorder Affect Tolerance and Outcomes in Men With Prostate Cancer Receiving Radiation Therapy? Am J Mens Health 2017;11(1): 5–12.
[32] Josephs CA, Shaffer VO, Kucera WB. Impact of Mental Health on General Surgery Patients and Strategies to Improve Outcomes. Am Surg 2022;31348221109469.