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ORIGINAL PAPER

Mindful Non-judging and Experiential Avoidance Before Allogeneic Hematopoietic Stem Cell Transplantation (HSCT) are Associated to Post-traumatic Stress Disorder (PTSD) Symptomatology 5 Months Later

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Abstract

Objectives Hematopoietic stem cell transplantation (HSCT) can be a traumatic experience for the patient, engendering psychological distress and sometimes post-traumatic stress disorder (PTSD). The aim of this study was to explore the relations between psychological resources (i.e., dispositional mindfulness, optimism, and acceptance) and deleterious factors (i.e., experiential avoidance and alexithymia) assessed before HSCT on PTSD symptomatology 5 months after transplantation. The relations between symptoms of PTSD and the five facets of dispositional mindfulness were also explored.

Methods Among the 187 patients who completed the first questionnaire measuring dispositional factors (i.e., dispositional mindfulness, acceptance, optimism, experiential avoidance, and alexithymia) prior to hospitalization, 91 patients were assessed at 5 months after HSCT on PTSD symptomatology. Various medical and mental health variables were controlled.

Results Acceptance, experiential avoidance, and the non-judging facet of mindfulness correlated significantly with PTSD symptoms at 5 months. Adjusting for major comorbid psychiatric disorders of PTSD (i.e., anxiety and depression), only experiential avoidance and mindful non-judging remained significant correlates of PTSD symptomatology. In addition, controlling for the same comorbidities, a binary logistic regression analysis revealed that only the non-judging facet of mindfulness is related to a lower risk of developing symptoms of PTSD ($OR = 0.38$, $p < .01$; 95% CI: 0.16, 0.95).

Conclusions This study highlights the importance of psychological constructs barely explored in HSCT. Cultivating a state of non-judgment and non-avoidance of internal experiences is negatively associated to PTSD symptoms following HSCT.

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Keywords Allogeneic hematopoietic stem cell transplantation · Hematological cancer · Post-traumatic stress symptomatology · Dispositional mindfulness · Experiential avoidance

Hematopoietic stem cell transplantation (HSCT) is a treatment often proposed in the case of hematological diseases such as acute leukemia or lymphoma (Copelan, 2006). However, this treatment can engender several adverse effects such as graft versus host disease (GvHD) and various infections which are deleterious for the quality of life and sometimes for the life prognosis (Braamse et al., 2012). The life-threatening nature and stressful aspects of HSCT, e.g., side effects, uncertainty, lack of control, and fear of relapse, can be traumatic experiences for the patient and may promote psychological distress (i.e., anxiety and depression symptomatologies) and post-traumatic stress disorder (PTSD). For example, between 26 and 36% of patients

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present moderate to severe symptoms of depression the first year after transplantation (Mosher et al., 2009). Forty-three point three percent have significant depression at 6 months after transplantation (El-Jawahri et al., 2016). About anxiety, the prevalence between before and 3 months after HSCT decreased from 29 to 19% and stays stable (Kuba et al., 2017).

This psychological distress is sometimes comorbid with PTSD symptomatology for which the prevalence ranges from 5 to 19% in the survivor population (Mosher et al., 2009). In other studies, the prevalence is 28.4% at 6 months (El-Jawahri et al., 2016) and 6 to 9% at 7 months after transplantation (Jacobsen et al., 2002), and up to 15% met the criteria of PTSD symptomatology at least once during the course of their treatment (between conditioning and 12 months after) (Esser et al., 2017).

PTSD symptomatology reflects a state of stress that has exceeded the individual's resources. PTSD can be encountered when people are confronted to "death, threatened death, or actual or threatened serious injury" (DSM-V) which is potentially the case of some patients involved in HSCT process. It is characterized by manifestations such as avoidance of situations related to the traumatic event, physiological hyperarousal (hypervigilance toward threats, irritability, sleep disturbances), and re-experiencing the event (i.e., intrusive thoughts). People can show PTSD symptoms, but the diagnosis of PTSD is only indicative when symptoms last at least 1 month and impair the daily functioning (DSM-V).

In the context of HSCT, psychological distress, a history of psychological disturbance, reduced psychological functioning and social support, avoidance coping strategy, and negative life events are associated with higher PTSD symptomatology (Jacobsen et al., 2002; Mosher et al., 2009). El-Jawahri et al. (2016) explored the predictive role of quality of life and mood (i.e., depression and anxiety) on PTSD symptomatology at the beginning of the disease, during hospitalization, and 6 months after transplantation. They found that an alteration in QoL and more depressive symptoms 2 weeks after HSCT hospitalization were predictive of PTSD symptoms 6 months later. Thus, difficulties during hospitalization impact both the lived experience in a protected area and mental health several months after HSCT (Biagioli et al., 2016; Tecchio et al., 2013). In addition, Esser et al. (2017) showed that being impaired by pain, the pain level, being female, an acute GvHD, and a longer stay in hospital are predictive of a greater PTSD symptomatology until 12 months after HSCT. Finally, factors such as uncertainty, appearance and sexuality, and health burden appear as predictors of PTSD symptomatology before and 12 months after HSCT when cancer-and-treatment-specific distress are measured (Kuba et al., 2017).

Among the psychological constructs identified as predictors of PTSD in oncological setting, some emerge as meaningful (Shand et al., 2015). Nowadays, psychological resources such as resilience or optimism are also studied to explore their protective role on mental health and on psychological disorder such as PTSD (Campo et al., 2017; Yang et al., 2016).

More recent constructs such as experiential avoidance have been identified as a trans-diagnostic meta-process involved in the maintenance of emotional disorders (e.g., anxiety and depression) and post-traumatic stress symptoms (Bardeen & Fergus, 2016). The same is true for some protective or positive dispositions that may buffer PTSD symptomatology. Through a reduction in depression, optimism (Amonoo et al., 2019), a sense of global meaning (Johnson Vickberg et al., 2001), and resilience (Campo et al., 2017) are associated with better outcomes in HSCT, including a reduced risk of PTSD. Other factors such as dispositional mindfulness (Larson et al., 2019) and some coping strategies (Barata et al., 2018) are also predictive factors of a poor recovery, as evidenced by anxiety, depression, or PTSD symptoms after HSCT.

About dispositional mindfulness, Baer et al. (2008) identified five facets of mindfulness: observing, describing, non-judging, non-reacting, and acting with awareness. These facets reflect the characteristics of mindfulness which consist of "intentionally paying attention to internal experiences (sensations, emotions, thoughts, states of mind) or external experiences of the present moment, without making value judgments" (Kabat-Zinn, 2009). Mindfulness can also be viewed as a disposition that varies across individuals, which is possible to promote through practice (Quaglia et al., 2016). Mindfulness as a disposition is now recognized as a protective factor promoting resilience, well-being, and physical/psychological health in the general population (Tomlinson et al., 2018) as well as in cancer patients (Garland et al., 2017; Tamagawa et al., 2013). In addition, mindfulness-based interventions can reduce post-traumatic avoidance symptoms when cancer patients continue to practice them regularly (Bränström et al., 2012).

To our knowledge, dispositional mindfulness has been studied in one research study on HSCT (Larson et al., 2019). The main results showed that patients who were able to describe, act with awareness, and were non-judgmental and non-reactive toward their thoughts and feelings experienced less depression and anxiety (except for the non-judgment facet). In addition, acting with awareness and non-judgment of experience were associated with less intrusive thoughts, a symptom of PTSD. In this study, experiential avoidance was also investigated, but no significant effect emerged despite its relations with dispositional mindfulness, mental health, and PTSD symptoms in other studies (Bardeen & Fergus, 2016; Thompson & Waltz, 2010).

Acceptance is quite well-recognized as an effective coping strategy in facing a stressful event such as cancer (Kvillemo & Bränström, 2014; Nipp et al., 2016). Studies on the case of HSCT are more focused on avoidance or resignation coping strategies than on acceptance, despite some interventional studies exploring the effects of third-wave behavioral psychotherapies such as mindfulness interventions (Bauer-Wu et al., 2008). However, even if experiential avoidance and the avoidance coping strategy are indeed correlated, they reflect two distinct dimensions (Karekla & Panayiotou, 2011).

Little is known about psychological dispositions buffering or favoring PTSD in the case of HSCT. The aim of this study was to examine the relations between several psychological dispositions assessed before hospitalization for HSCT and PTSD symptomatology 5 months after transplantation. Two negative dispositional factors—barely explored in HSCT—were assessed: alexithymia, considered as a subset of experiential avoidance and related to PTSD (Thompson & Waltz, 2010), and experiential avoidance. Three positive dispositions (i.e., the five facets of dispositional mindfulness, acceptance, and optimism) were investigated. Because it was not possible to control directly for post-transplant PTSD before hospitalization, we controlled for the expected relations by variables that co-occur with PTSD (i.e., comorbidities: depression and anxiety).

We suggest that higher alexithymia and experiential avoidance would be associated to greater symptoms of PTSD at 5 months post-transplantation, whereas higher levels of acceptance, optimism, and dispositional mindfulness would be associated with less PTSD symptoms. We explored more precisely each of the five facets of dispositional mindfulness to determine their respective relation to PTSD symptomatology, with the specific prediction that mindful non-judging would be associated to a reduced risk of PTSD symptomatology (Wahbeh et al., 2011).

With the exception of PTSD, which was measured 5 months after transplantation (time 2), all other measures were assessed before hospitalization (time 1). To determine the prospective effect of a variable measured at time 1 on PTSD assessed at time 2, PTSD must be controlled for at time 1. However, for PTSD, this can only be done indirectly, either by controlling for PTSD at time 1 regarding an event other than the upcoming transplant or by controlling for the major comorbid psychiatric disorders of PTSD at time 1 (i.e., depression and anxiety; Spinhoven et al., 2014). In this study, we opted for this second option. Thus, for each time 1 variable significantly correlated with PTSD (time 2), we assessed its prospective effect by statistically controlling for comorbid psychiatric disorders at time 1 in a partial correlation analysis.

Methods

Participants

Two hundred and fifty-seven patient candidates for an allogeneic transplantation were invited to participate to the "Psy-Greffe" protocol. Among them, 70 declined to participate for various personal reasons. The recruited sample filled out two questionnaires: one before hospitalization (time 1) and one 5 months after the allograft (time 2). One hundred and eighty-seven participants filled out the first questionnaire ($M_{age} = 52.07$, $SD = 13.22$, age range from 19 to 72 years old). Ninety-one completed the second one 5 months after the transplantation ($M_{age} = 51.61$, $SD = 12.93$, age range from 23 to 70 years old). Between time 1 and time 2, 30 participants died. In addition, 67 participants left the study between T1 and T2 for various reasons (e.g., fatigue, lack of motivation). Participants came from three hospital centers in France. Among those who completed the second one, 42.7% were women. Among the 91 patients who provided information, 48% were married, 46.1% of our sample had an educational level above the license degree, and 67.6% were employed. Among the candidates, 36.3% of them had acute leukemia, 13.8% had non-Hodgkin's lymphomas, and 13.8% had myelodysplastic syndromes. For 96.3% of them, this was their first transplantation. Finally, for 31.3% of them, the graft came from a matched unrelated donor (Table 1). We estimated the required sample size for sufficient correlation power (90%). On the basis of the correlations between optimism and PTSD symptomatology reported by Liu et al., (2015; i.e., $r = -0.452$), and between dispositional mindfulness and symptoms of PTSD reported by Liu et al., (2018; i.e., $r = -0.472$), using the lower r (0.452), the minimum required sample size was 47. The ethical committee Sud-Est III (IRB 2017–026 B) approved this study and informed consent was obtained from all patients included in the study.

Procedures

All participants were informed of the study during the pre-graft interview and read an information note. Next, they completed an informed consent form and completed a self-report questionnaire assessing several psychological dimensions and sociodemographic variables 19.6 days before transplantation (time 1). The second questionnaire assessing PTSD symptoms was proposed 5 months

Table 1 Descriptive statistics for sociodemographic and medical variables at time 1 and time 2

	Time 1			Time 2		
	% (excluding missing values)	Mean (SD)	*N*	% (excluding missing values)	Mean (SD)	*N*
Controlled sociodemographic variables						
Age		52.03 (13.28)	217		51.61 (12.93)	89
Sex (*women*)	42.7		221	42.7		89
Marital status (*married*)	46.4		181	48		75
Educational level (*post-graduate*)	46.3		175	46.1		76
Socio-professional category (*employed*)	69.6		151	67.6		68
Follow-up (in months)		6.58 (4.04)				
Controlled medical variables						
Disease status			178			80
Acute leukemia	36			36.3		
Myelodysplastic syndrome	17.4			13.8		
Myeloproliferative neoplasia	10.1			8.8		
Non-Hodgkin lymphoma	11.8			13.8		
Alcohol consumption (*yes*)	30.8		172	22.5		71
Smoking (*yes*)	15.8		177	8		75
Physical activity (*yes*)	45.3		172	54.8		73
Body mass index		24.92 (4.61)	176		24.19 (4.22)	74
Sleeping hours		7.42 (1.15)	161		7.29 (1.15)	68
Number of transplantations		1.07 (0.3)	178		1.04 (.19)	80
Latency between disease diagnostic and transplantation (*in years*)		2.61 (4.41)	178		3.03 (4.69)	80
Myeloablative conditioning	25.8		178	25		80
Chronic GvHD	16.5		164	18.1		72
Donor type			179			80
Identical sibling	25.7			31.3		
Mismatched unrelated	8.9			8.8		
Mismatched relative	12.8			8.8		
Matched unrelated	38			41.3		
Unrelated	14			8.8		
Matched other relatives	0.6			1.3		
Latency engraftment (*in days*)		20.24 (6.95)	161		19.85 (5.67)	73
Acute GvHD	51.5		171	57.9		76
Relapse	14.8		162	5.6		72
Number of infections		2.14 (1.8)	170		1.87 (1.82)	76
Death	16.4		177	1.3		80

(± 1 month) after the allograft (time 2). The relevant medical data were extracted from the ProMISe (Project Manager Internet Server) database.

Measures

Psychological Dispositions (Time 1) Two constructs were used to assess negative psychological dispositions: alexithymia and experiential avoidance. The Toronto Alexithymia Scale (TAS-20) was used to assess alexithymia (Parker et al., 1993) with a satisfactory reliability ($\alpha = 0.81$). Experiential avoidance was measured with the Avoidance and Fusion Questionnaire for Adults (AFQ) (Fergus et al., 2012) ($\alpha = 0.88$). Three constructs were used to measure positive psychological dispositions: optimism, mindfulness, and acceptance. Optimism was measured using the Life Orientation Test revised (LOT-R) (Scheier et al., 1994) ($\alpha = 0.71$). The Five Facets Mindfulness Questionnaire (FFMQ) (Baer et al., 2008) was used to measure dispositional mindfulness. This scale comprises five dimensions: observing, describing, acting with awareness, non-judging, and non-reactivity to the

experience. The total reliability was adequate ($\alpha = 0.87$). Finally, acceptance was assessed with the Acceptance and Action Questionnaire II (AAQ II) (Schmalz & Murrell, 2010) ($\alpha = 0.79$).

Post-traumatic Stress Disorder (Time 2) Post-traumatic Stress Disorder Checklist (PCL) (Weathers et al., 1993): This scale is used to detect post-traumatic stress symptomatology through 17 items assessing the severity of 17 symptoms of PTSD listed in the DSM-IV-TR (2000). This scale was assessed 5 months after HSCT (± 1 month). For each item, individuals indicate how much they have experienced these symptoms during the last month from 1 ("Not at all") to 5 ("Very often"). A score above 34 is considered to be clinical and requires psychological care. This scale has a good internal consistency ($\alpha = 0.91$).

Comorbid Psychiatric Disorders of PTSD (Time 1) Anxiety and depression were measured in the first questionnaire at time 1, at the same time as psychological dispositions. Anxiety and depression were assessed with the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). Seven items estimate anxiety symptomatology and seven items assess symptoms of depression. The anxiety and depression subscales had satisfactory internal reliability (respectively, $\alpha = 0.76$ and $\alpha = 0.70$).

Control Variables Covariates in this study included sociodemographic variables (i.e., sex, age, educational level, marital status, and socio-professional category), and medical variables (i.e., alcohol consumption, smoking, physical activity, body mass index (BMI), sleeping hours, type of disease, number of transplantations, the latency time between disease diagnosis and transplantation, regimen conditioning, the type of donor, chronic graft versus host disease (GvHD), acute GvHD, latency between transplantation and engraftment, the presence of relapse or not, and the number of infections).

Data Analyses

Jamovi 1.8.2.0 was used to compute descriptive statistics and normality test, and to test the hypotheses. A Cronbach alpha has been computed for each scale. Then, means, standard deviations, minimum/maximum, and Shapiro–Wilk W were determined for all variables. Except for alexithymia and optimism, using one-sample t test, we compared all scales' means with threshold scores from general population. To determine which variables correlated significantly with PTSD symptomatology, zero-order correlations were first calculated. For significant correlates, in addition, we computed the odd ratio (confidence interval: 95%) related to the risk to develop PTSD using binary logistic regressions. Finally, prospective effects were tested by controlling for variables that co-occur with PTSD (i.e., depression and anxiety) in a series of partial correlation. This offers the possibility of calculating, in an indirect way, the prospective effect of variables measured before hospitalization on PTSD 5 months later.

Results

Descriptive Statistics

The mean on Post-traumatic Stress Disorder Checklist in our sample was 31.26 ($SD = 11.86$). Sixteen point three percent of patients were screened positive for PTSD when the threshold score used is beyond or equal to 44 (18.9% of women and 14.3% of men) and 32.6% were detected as positive to the PTSD symptomatology when the threshold score used is above 34 (Yao et al., 2003). Re-experiencing was the most reported symptom ($M = 3.84$, $SD = 2.74$). In addition, a significant proportion of women and men present scores above the normal on both anxiety (62.7% of women and 52.5% of men) and depression (17.1% of women and 24.2% of men) subscales (i.e., a score above 7 on the HADS).

The average score for experiential avoidance (i.e., 32.90, $SD = 12.08$) was significantly higher than the score of the general population (i.e., 20, $SD = 12.6$; $t = 14.48$, $p < 0.001$) (Schmalz & Murrell, 2010). Concerning dispositional mindfulness and its five facets, descriptive data revealed that acting with awareness ($M = 3.81$, $SD = 0.70$), observing ($M = 3.45$, $SD = 0.73$), and non-judging ($M = 3.37$, $SD = 0.71$) obtained the higher scores, followed by describing facet ($M = 3.26$, $SD = 0.76$) and non-reactivity ($M = 2.98$, $SD = 0.63$). Only the mean scores of non-judging and non-reactivity were not significantly different from those of Baer's et al. (2008) study (all $p > 0.24$). However, the patients in our sample scored significantly higher in observing and in acting with awareness and lower in describing their inner experience than participants in Baer's et al. study (all $p < 0.01$). Concerning acceptance, the mean score was significantly higher in our sample ($M = 47.05$, $SD = 9.32$) than in a sample from the general population ($M = 40.72$, $SD = 8.59$; $t = 9.212$, $p < 0.001$) (Fledderus et al., 2013) (see Supplemental Material).

We then checked the normality of the data using the Shapiro–Wilk test. It appears that most of the data do not have a normal distribution (i.e., PTSD: $W = 0.91$, $p < 0.001$; anxiety: $W = 0.98$, $p < 0.02$; depression: $W = 0.94$, $p < 0.001$; optimism: $W = 0.98$, $p < 0.007$; mindfulness—observing: $W = 0.98$, $p < 0.029$; mindfulness—act with awareness: $W = 0.97$, $p < 0.002$; mindfulness—non-reactivity: $W = 0.98$,

$p < 0.033$). Therefore, the relations between the variables will be analyzed using the Spearman correlation.

As expected, dispositional mindfulness was positively and significantly correlated with optimism and acceptance and negatively correlated with avoidance and alexithymia. Optimism and acceptance had a positive relation, whereas optimism and both experiential avoidance and alexithymia had a negative one. Finally, acceptance was negatively related to experiential avoidance and alexithymia.

Symptoms of Post-traumatic Stress Disorder, Sociodemographics, and Medical Variables

Among the sociodemographic-controlled variables, none was significantly related to symptoms of PTSD. We also explored the relation between relevant medical variables (i.e., acute GvHD, relapse, death) and PTSD. None of these variables was significantly related to PTSD symptomatology.

Relations Between PTSD and Comorbid Psychiatric Disorders

As expected, both anxiety (Rho = 0.41, $p < 0.001$) and depression (Rho = 0.34, $p < 0.01$) were significantly related to PTSD. Both correlated significantly with avoidance and hyperarousal (see Table 2).

Relations Between Post-traumatic Stress Symptomatology and Psychological Dispositions

Spearman correlations analyses revealed that PTSD was predicted by several psychological dispositions assessed prior to hospitalization for HSCT. Zero-order correlations are presented in Table 2. Acceptance (Rho = −0.29, $p < 0.01$) and experiential avoidance (Rho = 0.45, $p < 0.001$) significantly predicted PTSD symptomatology 5 months after HSCT. The more the patients accepted internal and external experiences, the less they reported PTSD symptoms 5 months after HSCT. On the contrary, the more the patients avoided their thoughts, emotions, and bodily sensations, the more they reported signs of PTSD. Alexithymia was not significantly related to PTSD symptoms (Rho = 0.03, $p < 0.19$) as well as dispositional mindfulness (Rho = −0.16, $p > 0.10$) and optimism (Rho = −0.21, $p < 0.10$).

As for the three main symptoms of PTSD, we can see that re-experiencing symptomatology was mainly related to experiential avoidance (Rho = 0.23, $p < 0.05$). Avoidance symptomatology was significantly related to two dispositions: acceptance (Rho = −0.29, $p < 0.05$) and experiential avoidance (Rho = 0.48, $p < 0.001$). Finally, only experiential avoidance (Rho = 0.33, $p < 0.01$) was significantly related to hyperarousal.

The Five Facets of Dispositional Mindfulness and PTSD Symptomatology

The facet of non-judging appears to be the main correlate of overall PTSD symptomatology (Rho = −0.42, $p < 0.001$), re-experiencing (Rho = −0.21, $p < 0.10$), avoidance (Rho = −0.40, $p < 0.001$), and hyperarousal (Rho = −0.34, $p < 0.01$). The more patients did not judge the experiences in their lives prior to hospitalization, the less they reported PTSD symptoms at 5 months after their transplantations. Act with awareness facet also predicts hyperarousal symptomatology (Rho = −0.26, $p < 0.05$).

Table 2 Zero-order Spearman correlations between psychological dispositions, comorbid psychiatric disorders of PTSD, and PTSD symptomatology

	PTSD	Re-experiencing	Avoidance	Hyperarousal
Negative psychological dispositions				
Alexithymia	.03	.21+	.06	−.02
Experiential avoidance	.45***	.23*	.48***	.33**
Positive psychological dispositions				
Acceptance	−.29**	−.19	−.29*	−.18
Optimism	−.21+	−.07	−.16	−.21+
Dispositional mindfulness	−.16	−.12	−.22+	−.10
Observing	.15	.00	.06	.17
Describing	.01	−.13	−.03	.06
Act with awareness	−.21+	−.08	−.16	−.26*
Non-reactivity	−.02	−.03	−.11	−.08
Non-judgment	−.42***	−.21+	−.40***	−.34**
Comorbid psychiatric disorders of PTSD				
Anxiety	.41***	.15	.39***	.31**
Depression	.34**	.22+	.25*	.39***

***$p < .001$; **$p < .01$; *$p < .05$, +$p < .10$

Test of Prospective Effects

To examine prospective effects, we computed partial Spearman correlations between PTSD (assessed at time 2) and psychological dispositions (measured at time 1) with comorbid psychiatric disorders of PTSD (assessed at time 1) as covariates (i.e., anxiety and depression; see Table 3). This allows us to examine, in an indirect way, the prospective effects of these variables assessed at time 1 (pre-hospitalization) on PTSD (5 months later). Controlling for anxiety and depression, we found that only experiential avoidance (partial Rho = 0.25, $p < 0.05$) and mindful non-judging (partial Rho = − 0.34, $p < 0.01$) remained significant correlates of PTSD symptomatology. As for the three PTSD symptoms, experiential avoidance was significantly related to avoidance symptoms of PTSD (partial Rho = 0.32, $p < 0.01$). Mindful non-judging was significantly related to overall PTSD symptomatology (partial Rho = − 0.34, $p < 0.01$), the avoidance symptoms of PTSD (partial Rho = − 0.35, $p < 0.01$), and hyperarousal (partial Rho = − 0.28, $p < 0.05$; see Table 3). A new relation appears between non-reactivity facet and hyperarousal symptomatology (partial Rho = 0.24, $p < 0.05$). However, since this relation was not present in the zero-order correlation, the probability that it is spurious is high, so it will not be interpreted.

In addition, controlling for anxiety and depression, a binary logistic regression showed that experiential avoidance was not significantly associated with a greater risk of developing PTSD symptomatology (OR = 1.67, $p < 0.32$; 95% CI: 0.62, 4.51). However, a similar analysis revealed that the non-judging facet of mindfulness is related to a lower risk of developing symptoms of PTSD (OR = 0.38, $p < 0.01$; 95% CI: 0.16, 0.95).

Discussion

This study aimed to explore the relations between several psychological dispositions and PTSD symptomatology that are barely explored in studies of hematopoietic stem cell transplantation, namely, experiential avoidance, dispositional mindfulness, and acceptance. Optimism was also investigated in order to confirm its role in PTSD symptomatology 5 months after HSCT. Alexithymia was also explored.

We expected that patients with higher levels of dispositional mindfulness, acceptance (i.e., a construct reflecting psychological flexibility and a component of a mindful state), and optimism would have a lower tendency to report PTSD symptoms at the 5-month follow-up (i.e., re-experiencing, avoidance, and hyperarousal). Conversely, we suggested that experiential avoidance, a factor involved in psychological disorders, would be positively related to PTSD symptomatology. In addition, we explored the individual relation of each facet of dispositional mindfulness to identify which one was the most related to symptoms of PTSD. We expected that the non-judging facet would be strongly related to PTSD symptomatology.

The results of this study partially support our hypotheses. Several psychological dispositions assessed prior to hospitalization were significantly related to PTSD symptomatology 5 months after HSCT, even after adjusting for anxiety, a significant comorbid psychiatric disorder. Experiential avoidance was significantly associated with symptoms of PTSD and particularly with avoidance. Patients with predispositions to avoid their thoughts, feelings, and bodily sensations prior to hospitalization were those who experienced avoidance symptoms 5 months after HSCT (i.e., avoidance of situations and triggers that might remind them of the HSCT). On the contrary, acceptance was negatively related to PTSD and avoidance symptomatology. After controlling

Table 3 Partial Spearman correlations between psychological dispositions at time 1 and PTSD symptomatology at time 2 controlling for comorbid psychiatric disorders of PTSD at time 1 (anxiety and depression)

	PTSD	Re-experiencing	Avoidance	Hyperarousal
Negative psychological dispositions				
Alexithymia	− .12	.16	− .07	− .15
Experiential avoidance	.25*	.16	.32**	.14
Positive psychological dispositions				
Acceptance	− .02	− .08	− .09	.13
Optimism	.04	.04	.06	.04
Dispositional mindfulness	.04	− .05	− .08	.08
Observing	.16	.00	.07	.17
Describing	.14	− .07	.05	.18
Act with awareness	− .02	.00	− .01	− .12
Non-reactivity	.15	− .01	.04	.24*
Non-judgment	− .34**	− .19	− .35**	− .28*

***$p < .001$; **$p < .01$; *$p < .05$; +$p < .10$

for anxiety, these relations disappeared. In Thompson and Waltz's (2010) study, acceptance also had a weak relation with PTSD. The same pattern was obtained with optimism. This suggests that covariates such as pre-transplant depression and anxiety explain the effects of acceptance and optimism. Indeed, it is well known that depression and anxiety are strong comorbid psychiatric disorders of PTSD in the context of HSCT (El-Jawahri et al., 2016).

Finally, interesting results emerged from the investigation of the five facets of dispositional mindfulness. In fact, only one of the five facets, mindful non-judging, was a robust correlate of PTSD symptomatology, even after controlling for a comorbid psychiatric disorder. Patients who generally tended to not judge their inner experiences reported less PTSD symptoms (especially less avoidance and physiological hyperarousal). This result is consistent with several works highlighting the protective role of non-judging in PTSD symptomatology (Thompson & Waltz, 2010; Wahbeh et al., 2011). Mindful non-judging is a particular characteristic of mindfulness that is different from most of the other components reflecting awareness (i.e., observing, describing, and acting with awareness). Non-judging can facilitate acceptance (Baer et al., 2004). In a study of Cardaciotto et al. (2008), mindful acceptance was negatively correlated with experiential avoidance, whereas mindful awareness was not. As suggested by the authors, acceptance and awareness would be two orthogonal constructs, and Bear et al. (2004) suggested that in a non-meditative sample, awareness of inner experience is not essential for engendering changes and promoting benefits associated with the practice of mindfulness (Bishop et al., 2004). Indeed, despite having awareness, non-meditative people tend to judge their own experiences, which blocks the positive effects of the practice. Our results are congruent with studies showing that people with better psychological flexibility (e.g., abilities to being mindful, accepting, and non-judgmental of their inner experiences) have less psychological impairments (Feros et al., 2013; Hulbert-Williams et al., 2015). On the contrary, those who report experiential avoidance (a component of psychological inflexibility) report more psychological distress, which is consistent with previous findings among cancer patients showing that emotional suppression, for example, is related to higher mood disorders (Aguirre-Camacho et al. 2017; Tamagawa et al., 2013).

Few studies explored the role of such factors on overall PTSD symptomatology in the case of patients who had undergone allogeneic HSCT. Larson's (2019) study also investigated the effect of experiential avoidance and mindfulness on anxiety, depression, and both physical and psychological functioning related to HSCT 5 months after transplantation. They did not find the same pattern of results since experiential avoidance and non-judging were not predictive of anxiety symptomatology. This suggests that psychological determinants of anxiety and symptoms of PTSD after HSCT are not necessarily the same.

Limitations and Future Research

The sample size of the present study limits the generalization of our results. Studies with larger sample sizes are required. While all of our predictive factors can be considered stable characteristics, they have only been assessed at one time. Repeated evaluations during the HSCT process would allow this stability to be assessed and potential changes to these provisions to be considered during the process (pre-transplant, during, and post-transplant).

In addition, we can mention several common method biases (i.e., same order of scales, proximity of conceptual relation between items) in this study given that numerous scales were proposed in questionnaires, leading potentially to erroneous correlations between variables (Podsakoff et al., 2012).

Further findings about protective and deleterious factors involved in the recovery after HSCT are necessary to provide more evidence about the role, and eventually the prospective influence, of factors such as experiential avoidance and non-judgment dimensions on PTSD symptomatology in this population. Such evidence would open a gate to propose avenues of psychotherapeutic interventions (Hulbert-Williams et al., 2015).

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Author Contribution All co-authors participated to the protocol conception, the acquisition of data, and the paper writing and approved the submitted version of the manuscript. MC and MD: developed the questionnaire and the general protocol, collected and treated the data, and wrote the paper. IB: contributed to the compliance with ethical standards by the ethics consideration management during the protocol time and participated to the data collection. AC: helped in the compliance with ethical standards, collected questionnaires in Estaing Hospital. MTR: participated to the design of the work and the interpretation of data and served as coordinator for collection of questionnaires in Nancy Brabois Hospital. JOB: participated to the design of the work and the interpretation of data and served as coordinator for collection of questionnaires in Estaing Hospital. RPD: contributed to the protocol development and the interpretation of data and served as coordinator in chief in Saint-Louis Hospital.

Data Availability All data are available at Figshare: https://figshare.com/s/a5ed18fbd274dbb4b063

Declarations

Ethics Approval This study was approved by the ethical committee Sud-Est III (IRB 2017–026 B)-Eastern Hospital Group and registered in the Registry Clinical Trial under NCT03883672 (https://clinicaltrials.gov/). All patients provided written informed consent.

Consent to Participate Informed consent was obtained from all patients included in the study.

Conflict of Interest The authors declare no competing interests.

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