

ORIGINAL ARTICLE

Sexual functioning in patients undergoing bone marrow transplantation: a longitudinal study

CT Humphreys¹, B Tallman¹, EM Altmaier¹ and V Barnette²

¹Department of Psychological and Quantitative Foundations, The University of Iowa, Iowa City, IA, USA and ²Counseling and Testing Center, University of North Carolina at Greensboro, Greensboro, NC, USA

Patients undergoing bone marrow transplantation (BMT) reported numerous sexual difficulties pretransplantation and at 1- and 3-years post transplantation. The most commonly reported problems pretransplant were a lack of sexual interest for men and self-perceived unattractiveness for women. At year 1, men reported more concern about physical attractiveness and increased problems with erection, ejaculation and orgasm. Women reported more sexual problems across all categories. At year 3, difficulties for men remained relatively consistent or decreased compared to year 1 with the exception of an increased concern about physical appearance. At year 3, women reported increased sexual interest; concerns about body appearance, vaginal dryness, painful intercourse and orgasm remained higher than at baseline, although all had decreased from year 1. Half of patients at all time points reported no discussion of sexuality with their health care provider. Baseline level of depression was significantly and positively related to sexual functioning at year 3 post transplant. These results suggest that sexual problems are significant for BMT survivors and that treatment of depression and health-care-provider education are possible interventional targets for improving sexual function and quality of life following BMT.

Bone Marrow Transplantation (2007) 39, 491–496.
doi:10.1038/sj.bmt.1705613; published online 26 February 2007

Keywords: sexual functioning; quality of life; patient-physician communication

Introduction

Few studies have specifically examined sexual functioning and its relationship to other quality of life and treatment variables in bone marrow transplantation (BMT) survivors. Quality of life studies have shown that sexual dysfunction and dissatisfaction are frequently reported among BMT

patients, although with varying rates.^{1–6} Despite the apparent prevalence of sexual issues in BMT survivors, there have been few longitudinal studies examining sexual functioning in this population. Most studies of sexual functioning have used short follow-up periods (3–12 months) or have been cross-sectional in nature.^{7–9}

Among those studies that have been published, only one went beyond a 1-year follow-up.¹⁰ In that study, sexually active survivors completed measures of sexual activity, sexual problems (i.e., arousal, orgasm) and sexual satisfaction 1- and 3-years post transplant. Generally, women presented with more problems than men. Additionally, women's problems increased over time, whereas men's problems were more likely to resolve by 3 years. The authors concluded that sexual problems and sexual dissatisfaction were widespread in their sample.

The aim of the present study was to present a longitudinal examination of sexual functioning in BMT survivors at pretransplant and 1-year and 3-years post transplant. In this study, all patients were interviewed regarding sexual functioning and problems, including patients who were not sexually active.

Materials and methods

All participants in the current study were patients in the Unrelated Donor Marrow Transplantation Trial¹¹ (see Table 1 for demographic characteristics). Consenting adult patients ($n=314$) were also enrolled in a health-related quality of life substudy.¹² Baseline interviews took place before the procedure. Post-transplant interviews were scheduled at 100-day, 6-month, 1- and 3-year follow-up intervals, with sexual functioning questions asked at three time points (baseline, 1 year and 3 years). All interviews – approximately 45–60 min in duration – were conducted over the telephone; before each interview, patients received a package of response aids. If patients were too ill or tired to complete an interview within one session, two sequential sessions were conducted. Patient interviews were conducted in English unless a translator was required (four patients, five interviews).

The current study examined sexual functioning data collected at baseline, at the 1-year follow-up and at the 3-year follow-up and depression at baseline. Although 309

Correspondence: Dr EM Altmaier, Psych and Quant Fdns, The University of Iowa, 361 Lindquist Center, Iowa City, IA 52242, USA.
E-mail: elizabeth-altmaier@uiowa.edu
Received 10 July 2006; revised 13 December 2006; accepted 4 January 2007; published online 26 February 2007

Table 1 Demographics

Variable	Year 1 (n = 79)		Year 3 (n = 59)	
	N	%	n	%
<i>Gender</i>				
Male	42	53.2	33	55.9
Female	37	46.8	26	44.1
<i>Race</i>				
Hispanic	2	2.5	3	5.1
Black	3	3.8	2	3.4
White	74	93.7	54	91.5
<i>Education</i>				
Less than high school	3	3.9	4	7
High school (or equivalent)	22	28.6	18	31.6
More than high school	52	67.5	35	61.4
<i>Marital status</i>				
Single	25	32.5	25	43.9
Married	46	59.7	36	45.6
Separated	1	1.3	1	1.8
Divorced	5	6.5	5	8.8
<i>Income</i>				
<\$10 000	5	7.0	5	10
\$10 000–\$49 000	41	57.7	23	46
\$50 000–\$99 000	18	25.4	16	32
\$100 000+	7	9.9	6	12

Note: Age, $M = 34.5$; $s.d. = 10.39$; the value of n on which percentages are based varies because of missing data for some variables.

adult participants received a transplant within the trial, only 273 completed baseline assessment, 87 completed the 1-year follow-up and 64 completed the 3-year follow-up. A number of factors led to the reduction in numbers: death, re-hospitalization, relocation, illness, scheduling difficulties and participant refusal. Additionally, some patients completing the follow-up interviews did not complete the sexual functioning measures because of interview difficulty; for example, a participant may have been too ill to participate in more than a brief section of the interview. Last, a few patients were told by their health-care provider not to engage in sexual activity; this question preceded the sexual functioning measures and a positive response terminated this section of the interview. Thus, the data presented in this study come from two groups: (a) descriptive data on all patients who responded at any time point to the sexual functioning measures and (b) regression analyses on the subset of patients for whom data are available for all time points. The final N for current study consisted of 242 for baseline, one 79 year and three participants 59 year.

Measures

Depression. The Centers for Epidemiological Studies of Depression (CES-D) is a self-report questionnaire developed to measure depressive symptoms among chronically ill samples.¹³ The CES-D consists of 20 items; higher scores indicate higher levels of depression. Items measure how often depressive symptoms occurred in the past week on a scale of 0 (less than 1 day) to 3 (5–7 days). Scores on the CES-D range from 0 to 60; a score of 16 or more

is considered a suggested clinical level of depression. The CES-D has proven to be a valid and reliable instrument in measuring depression in cancer populations.^{14–16} Research has demonstrated high internal consistency reliability (0.85–0.90) and sufficient test–retest reliability (0.45–0.70).¹³

Sexual activity and problems. Sexual functioning was assessed by a questionnaire on sexual activity and sexual problems. Questions were derived from the Sexual History Form¹⁷ and the Sexual Problems Measure.¹⁸ Males and females who indicated that they were sexually active (with a partner) in the past 4 weeks completed a set of six questions concerning both desire- and function-related sexual problems. Desire items included ‘lack of sexual interest’ and ‘seeing myself as sexually attractive.’ Physical problems specific to females included ‘vaginal dryness’ and ‘painful intercourse.’ For males, ‘difficulty in achieving/keeping an erection’ and ‘premature ejaculation’ were reported as sexual problems. Participants responded to items using a 4-point scale (1 = not a problem, 4 = a serious problem); higher scores indicate more sexual functioning problems. Three scales were developed: Desire (problems in sexual desire), Function (problems in sexual function) and Total (total sexual problems). Internal consistency among scales was adequate ($\alpha = 0.72–0.84$) with one scale having poor reliability (for $Total_{Year 1}$, $\alpha = 0.34$). In addition to completing the desire and function questions, individuals who reported not being sexually active in the past 4 weeks completed a series of questions assessing reasons for not being sexually active (e.g., no partner, no opportunity). Last, all individuals responded either yes or no to the following question: ‘Excluding fertility issues, has your health care provider discussed the effect of your transplant on sexual activity or functioning?’

Statistical analyses

Because the primary purpose of this study was to provide descriptive statistics on the prevalence of sexual problems among sexually active and not sexually active BMT patients, the method of analysis was calculation of prevalence and the comparison of prevalence to a community sample. As sexual functioning can be influenced by depression (a common issue post-BMT), a secondary research question was whether baseline depression would adversely affect post-transplant sexual functioning. Although not an *a priori* hypothesis, an additional secondary research question was how demographic variables would affect post-transplant sexual functioning. Hierarchical multiple regression was used with both secondary questions.

Results

Prevalence of dysfunction

Sexual activity. At pretransplantation assessment, 59.9% of the participants had been sexually active in the preceding 6 months compared to 46.6% of the surviving participants at year 1 and 39.5% at year 3. In terms of more recent

Table 2 Percentage of sexual problems among participants

Scale/problem	Active						Not active					
	Males			Females			Males			Females		
	Pre	1 year	3 years	Pre	1 year	3 years	Pre	1 year	3 years	Pre	1 year	3 years
<i>Desire</i>												
Sexual interest	46	33	39	59	72	54	44	54	33	58	37	47
Body appearance	33	56	61	54	72	64	20	42	33	31	31	33
Sexually attractive	38	56	56	64	78	55	34	33	40	29	26	20
<i>Function</i>												
Erection/vaginal dryness ^a	33	50	22	49	78	72	12	25	13	23	21	27
Ejaculation/painful intercourse ^a	20	33	22	29	61	55	7	17	20	19	16	20
Orgasm	13	22	22	46	72	64	5	21	7	17	6	20

Note: Pre = pretransplant/baseline ($n = 273$); 1 year, 1-year post-transplant ($n = 87$); 3 years, 3-years post-transplant ($n = 64$).

^aGender-specific function (male/female).

sexual activity, 49.2% of participants had been sexually active in the past 4 weeks at baseline compared to 35.9% at year 1 and 35.85% at year 3. Over time, the trend appears to be a decrease in sexual activity as measured at pre-BMT and at 1- and 3-years post-BMT.

Participants who were sexually active reported a variety of desire and function problems at all three time points (see Table 2). At baseline, the most commonly reported problems were a lack of sexual interest for men and a lack of self-perceived attractiveness for women, both of which are contained in the desire subscale. At year 1, men reported more concern about their physical appearance and attractiveness than at baseline, as well as increased problems with obtaining an erection, ejaculation and orgasm. However, men reported less difficulty with lack of sexual interest at year 1 than at baseline. Women consistently reported more sexual problems at year 1 across all categories, with increased desire and functional difficulties including sexual interest, appearance, vaginal dryness, painful intercourse and difficulties with orgasm.

At year 3, men reported more concern with body appearance than at previous time points, but difficulties in other areas remained consistent or decreased when compared to year 1. Reported difficulties with orgasm, feelings of sexual attractiveness and ejaculation remained higher at year 3 than at baseline. Women at year 3 reported decreased concern about lack of sexual interest and sexual attractiveness compared to previous time points. Concerns about body appearance, vaginal dryness, painful intercourse and orgasm remained higher than at baseline although all had decreased from year 1 reports.

Community-living adults. It is important to note that sexual dysfunction is a common problem in the general population as well as among those with chronic medical conditions. However, in many cases, it appears that survivors of BMT are reporting higher levels of sexual dysfunction than the public at large. A review of the literature¹⁹ on prevalence of sexual dysfunction found that rates were as follows among community samples of men: 0–3% for male orgasmic disorders, 0–5% for erectile dysfunction and 4–5% for premature ejaculation. In contrast, men in the current sample reported the following

Table 3 Participants identifying themselves as sexually active or not sexually active and reason

Variable	Active			Not active		
	Pre	1 year	3 years	Pre	1 year	3 years
<i>Gender</i>						
Males	90	18	18	41	24	15
Females	63	18	11	48	19	15
<i>Reason^a</i>						
Partner				41 (46%)	15 (35%)	18 (60%)
Opportunity				30 (34%)	16 (37%)	13 (43%)

Note: Pre = pretransplant ($n = 273$); 1 year, 1-year post-transplant ($n = 87$); 3 years, 3-years post-transplant ($n = 64$).

^aTotal of not sexually active participants lacking partner or opportunity.

rates: 5–21% for difficulty with orgasm, 12–25% for erectile dysfunction and 7–20% for ejaculatory problems. Data were less available for females, but community samples reported rates of 7–10% for female orgasmic disorders, with the current sample reporting difficulty with orgasm at rates of 6–20%. In addition, females in the current sample reported above 15% (and as high as 58%) for all other assessed sexual difficulties.

No sexual activity. Although they may not have sexual relations with an intimate partner, patients can experience sexual problems. Participants who were not sexually active at baseline most frequently cited lack of partner as the reason followed by lack of opportunity. This pattern remained consistent for not sexually active participants at 1- and 3-years post BMT (see Table 3).

Overall, not sexually active participants reported fewer sexual difficulties. At baseline, the most common complaints for men and women were lack of sexual interest followed by sexual attractiveness and body appearance (see Table 2). This pattern remained at year 1 for both men and women. At year 3, men reported concern about sexual attractiveness most frequently, followed by lack of interest and body appearance. Women at year 3 continued to most commonly report lack of sexual interest, followed by body appearance and vaginal dryness.

Table 4 Pearson correlations with reported sexual dysfunction

Variable	Total			Desire			Function		
	Pre	1 year	3 years	Pre	1 year	3 years	Pre	1 year	3 years
Age	0.094	0.279	-0.165	0.059	0.207	-0.218	0.108	0.262	-0.100
Education	-0.077	0.150	0.100	-0.076	0.064	0.025	-0.053	0.095	0.141
Gender	0.316**	0.387*	0.356	0.271**	0.264	0.109	0.272**	0.373*	0.488**
Income	-0.103	-0.095	-0.076	-0.081	-0.174	-0.009	-0.099	-0.169	-0.118
Marital	0.035	0.074	-0.036	0.059	0.268	-0.157	-0.007	-0.166	0.061
Depression	0.429**	0.080	0.444*	0.406**	0.071	0.459*	0.323**	0.077	0.472*

Note: Desire = desire scale; Function = function scale; Total = total scale; Pre = pretransplant/baseline ($n = 273$); 1 year, 1-year post-transplant ($n = 87$); 3 years, 3-years post-transplant ($n = 64$); Education = years of education; Income = total income; Marital = marital status; Depression = baseline depression (CES-D total score).

* $P < 0.05$; ** $P < 0.01$.

Discussion with Health Care Providers. Participants were also asked whether their health care providers discussed the consequences of BMT on sexual functioning (excluding fertility issues). At baseline assessment, 47.6% of participants reported that their health-care provider did not discuss the effects of BMT on sexual functioning. At 1 year, 53.4% reported no discussion on this topic, and 49.4% indicated that there was no discussion of sexual functioning at 3-years post transplant.

We examined the relationship between health care provider discussion at baseline and sexual activity and functioning using bivariate correlations. There was a significant relationship at year 3 post-transplant, in which patients who had a discussion of transplant effects on sexuality with their health care provider reported fewer sexual functioning problems ($r = -0.43$, $P = 0.02$). Although this is a preliminary result, it suggests that the influence of health care provider discussion of sexual dysfunction may bear further investigation. However, it may be equally true that more sexually active or interested participants may have initiated such a discussion with their health care provider.

Statistical analysis

Demographic variables and depression. Relationships between demographic variables and sexual functioning in sexually active participants were examined in a bivariate correlation matrix (see Table 4). Gender was the only demographic variable significantly related to sexual functioning. Significant relationships between gender and sexual functioning emerged at baseline for total, desire and physical function, with females reporting more problems. At 1- and 3-years post-BMT, this pattern remained significant for total sexual problems and physical function. We next examined the relationship between pretransplantation depression levels and sexual functioning. Depression was significantly and positively related to desire, physical function and overall problems at baseline and at 3-years post BMT.

Predicting sexual functioning post BMT. Before regression analyses were conducted, bivariate distributions between control and study variables were examined for nonlinearity and outliers. Normal distributions were present. Further,

Table 5 Summary of multiple hierarchical regression analysis for variables predicting total sexual problems post-BMT

Variable ^a	Year 1				Year 3			
	B	SE B	β	ΔR^2	B	SE B	β	ΔR^2
Block 1								
Gender	2.7	1.3	0.38*	0.13*	2.6	1.5	0.30	0.13
Block 2								
Depression	-0.02	0.06	-0.06	0.00	0.21	0.09	0.40*	0.15*

Note: For year 1, $R^2 = 0.13$ for overall model ($n = 36$). For year 3, $R^2 = 0.28$ ($P < 0.05$) for overall model ($n = 29$). For gender, male = 0 and female = 1.

^aFor block 1, covariates.

* $P < 0.05$.

Table 6 Summary of multiple hierarchical regression analysis for variables predicting sexual desire post-BMT

Variable ^a	Year 1				Year 3			
	B	SE B	β	ΔR^2	B	SE B	β	ΔR^2
Block 1								
Gender	0.74	0.60	0.22	0.05	0.14	0.73	0.03	0.01
Block 2								
Depression	-0.00	0.03	-0.01	0.00	0.11	0.04	0.45*	0.20*

Note: For year 1, $R^2 = 0.05$ for overall model ($n = 36$). For year 3, $R^2 = 0.21$ ($P < 0.05$) for overall model ($n = 29$). For gender, male = 0 and female = 1.

^aFor block 1, covariates.

* $P < 0.05$.

an interactions term was created between gender and depression and no interaction was present; thus, main effects could then be examined. Hierarchical regression was used to examine further the relationships among depression, gender and sexual functioning. Gender was entered into the first block of the regression and baseline depression was entered in the second. The unique variance of gender and depression on sexual functioning was examined. With total sexual functioning, sexual desire and physical function scales at years 1 and 3 as dependent variables, five regressions were performed (see Tables 5–7). Because of poor reliability, the year 1 function scale was not analyzed.

Table 7 Summary of multiple hierarchical regression analysis for variables predicting physical functioning 3 years post BMT

Variable ^a	B	SE B	β	ΔR^2
<i>Block 1</i>				
Gender	2.4	0.90	0.44*	0.23**
<i>Block 2</i>				
Depression	0.10	0.05	0.29	0.08

Note: Because of poor reliability ($\alpha=0.34$), year 1 regression was not run. For year 3, $R^2=0.32$ ($P<0.01$) for overall model ($n=29$). For gender, male = 0 and female = 1.

^aFor block 1, covariates.

* $P<0.05$; ** $P<0.01$.

Analysis of year-1 data showed that gender was a significant predictor of total sexual problems ($\beta=0.38$, $P=0.04$). Gender uniquely accounted for 13% variance in total sexual problems at year 1, $F_{inc}(1, 35)=4.9$, $P=0.03$, with women reporting more overall problems. At year-3 post BMT baseline depression was a significant predictor of total sexual problems ($\beta=0.4$, $P=0.03$) and uniquely accounted for 15% variance, $F_{inc}(1, 26)=5.52$, $P=0.03$. In addition, at year 3, depression was a significant predictor of sexual desire problems ($\beta=0.45$, $P=0.02$) and uniquely accounted for 20% variance, $F_{inc}(1, 26)=6.61$, $P=0.02$. Last, gender significantly predicted sexual physical functioning problems ($\beta=0.44$, $P=0.02$) at year 3, and uniquely accounted for 23% in sexual physical functioning problems, $F_{inc}(1, 27)=8.42$, $P=0.007$. At year 3, women reported more physical functioning problems than men.

Discussion

The results of the current study have several important implications for health practitioners. First, sexual dysfunction in the form of lack of desire, body image problems and physical functioning is a salient issue for patients undergoing BMT. This finding is consistent with previous studies that have examined sexual functioning specifically⁷⁻¹⁰ or as part of a larger quality of life assessment in BMT recipients.¹⁻⁶

Compared to a previous study¹⁰ of sexual functioning that included baseline, 1- and 3-year time points, our participants reported more sexual difficulties pretransplantation in terms of orgasm (14 vs 46% for women; 4 vs 13% for men) vaginal dryness (30 vs 49%), erectile dysfunction (13 vs 33%) and painful intercourse for women (14 vs 29%). At year 1, women in the current study reported significantly more problems compared to the previous study in terms of difficulties with orgasm (24 vs 72%), vaginal dryness (49 vs 78%) and painful intercourse (35 vs 61%). Men at year 1 showed a similar pattern, with a higher prevalence of difficulties with orgasm (3 vs 22%) and erectile dysfunction (15-18 vs 50%) in the current study. This pattern remained consistent at year 3, with both men and women reporting a higher prevalence of the difficulties listed above than in the previous study.

Having established that sexual functioning is a relevant issue for patients undergoing BMT and that sexual difficulties are highly prevalent in our sample, it is important to identify demographic and psychosocial variables related to sexual dysfunction. Results of this study indicate several important variables to consider and possible interventions to improve sexual functioning in this patient population. Our results indicate that women are more likely than men to report greater sexual difficulties across assessed domains and time points. This is important for health-care providers to consider, especially given the apparent infrequency of discussion of these issues with patients, another important finding of this study. Fewer than half of health-care providers discussed sexuality issues post-BMT with patients in this study other than the effect of this treatment on fertility. This omission is of great concern given the finding that discussion of this topic was related to improved sexual functioning at year 3 post-transplant. Although some health-care providers may consider sexuality and other quality of life issues to be secondary in the face of life-threatening illness,²⁰ there is a clear opportunity for a simple intervention to improve outcome simply by discussing transplant-related effects on sexuality with BMT patients.

Depression emerged as an important factor in these results. The finding that baseline, or pretransplantation, levels of depression are associated with sexual functioning at 3-year follow-up is very important to consider. For health-care providers working to improve post-transplant quality of life, depression emerges as a key target for assessment and intervention. Our results indicate that assessing for and addressing depression at the pretransplantation stage may be an important step in reducing sexual dysfunction following BMT, particularly in long-term survivors.

Overall, results of this study indicate that sexual difficulties are a significant issue for patients receiving this treatment. The effects of gender, health-care provider discussion of sexual issues and baseline depression were all found to be significant with regard to sexual problems both pretransplant and in long-term follow-up. This study has several limitations to consider. First, there was a relatively small sample size among sexually active participants, particularly at 3-year follow-up. Second, a scale (year 1 function) had to be excluded from analysis because of poor reliability. In addition, the sample used was primarily Caucasian and well educated, which may limit the generalizability of these results. We also do not have data on the ways in which the participants' marital or intimate relationships may have influenced their sexual functioning, a fruitful area for future inquiry. Despite these limitations, the current study makes a contribution to better understanding the phenomenon of sexual dysfunction in BMT patients as well as suggests targets for intervention in this area including depression and health care provider communication. Relatively few studies have examined this issue longitudinally, and even fewer have gone beyond 1-year post-transplant.^{10,21} As aggressive treatments become the norm and as long-term survival rates increase among BMT and other patient populations, continued long-term assessment of quality of life issues will

become more and more salient and the need for longitudinal research in this area will continue to grow. Sexual functioning is one quality of life variable that is in particular need of increased research, and future studies are needed to study the development and treatment of sexual dysfunction in BMT patients over time.

Acknowledgements

This research was supported by a contract from the National Heart, Lung, and Blood Institute (N01-HB-47097 [John Thompson], N01-HB-47094 [Shelly Carter], N01-HB-47098 [Nancy Kernan] and N01-HB-47095 [John Wagner]).

We acknowledge the gracious assistance of the transplantation centers and their staff: University of Minnesota, Memorial Sloan-Kettering Cancer Center, Medical College of Virginia, Wake Forest University – Baptist Center, University of Nebraska, University of Utah, Stanford University, University of Iowa, University of South Carolina, Ohio State University, Duke University, University of Kentucky, Medical College of Wisconsin, Western Pennsylvania Hospital, and University of Pittsburgh. We thank Joan Baenziger for her assistance in conducting interviews.

References

- Altmaier EM, Gingrich RD, Fyfe MA. Two-year adjustment of bone marrow transplant survivors. *Bone Marrow Transplant* 1991; **7**: 311–316.
- Chao NJ, Tierney DK, Bloom JR, Long GD, Barr TA, Stallbaum BA *et al*. Dynamic assessment of quality of life after autologous bone marrow transplantation. *Blood* 1992; **80**: 825–830.
- Vose JM, Kennedy BC, Bierman PJ, Kessinger A, Armitage JO. Long-term sequelae of autologous bone marrow or peripheral stem cell transplantation for lymphoid malignancies. *Cancer* 1992; **69**: 784–789.
- Whedon M, Stearns D, Mills LE. Quality of life of long-term adult survivors of autologous bone marrow transplantation. *Oncol Nurs Forum* 1995; **22**: 1527–1535.
- Baker F, Denniston M, Zabora JR, Marcellus D. Cancer problems in living and quality of life after bone marrow transplantation. *J Clin Psychol Med Settings* 2003; **10**: 27–34.
- Claessens JJM, Beerendonk CCM, Schattenberg AVMB. Quality of life, reproduction and sexuality after stem cell transplantation with partially T-cell-depleted grafts and after conditioning with a regimen including total body irradiation. *Bone Marrow Transplant* 2006; **37**: 831–836.
- Marks DI, Friedman SH, Delli CL, Nezu CM, Nezu AM. A prospective study of the effects of high-dose chemotherapy and bone marrow transplantation on sexual function in the first year after transplant. *Bone Marrow Transplant* 1997; **19**: 819–822.
- Schimmer AD, Ali K, Stewart AK, Imrie K, Keating A. Male sexual function after autologous blood or marrow transplantation. *Biol Blood Marrow Transplant* 2001; **7**: 279–283.
- Watson M, Wheatley K, Harrison GA, Zittoun R, Gray RG, Goldstone AH *et al*. Severe adverse impact on sexual functioning and fertility of bone marrow transplantation, either allogeneic or autologous, compared with consolidation chemotherapy alone: analysis of the MRC AML 10 trial. *Cancer* 1999; **86**: 1231–1239.
- Syrjala KL, Roth-Roemer SL, Abrams JR, Scanlon JM, Chapko MK, Visser S *et al*. Prevalence and predictors of sexual dysfunction in long-term survivors of marrow transplantation. *J Clin Oncol* 1998; **16**: 3148–3157.
- Wagner JE, Thompson JS, Carter SL, Kernan NA. Effect of graft-*vs*-host disease prophylaxis on 3-year disease-free survival in recipients of unrelated donor bone marrow (T-Cell Depletion Trial): a multi-centre, randomised phase II-III trial. *Lancet* 2005; **366**: 733–741.
- Altmaier EM, Ewell M, McQuellon R, Geller N, Carter S, Henslee-Downey J *et al*. The effect of unrelated donor marrow transplantation on health-related quality of life: a report of the Unrelated Donor Marrow Transplantation Trial (T-cell Depletion Trial). *Biol Blood Marrow Transplant* 2006; **12**: 648–655.
- Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Measurement* 1997; **1**: 385–405.
- Beeber LS, Shea J, McCorkle R. The Center for Epidemiological Studies Depression scale as measure of depressive symptoms in newly diagnosed cancer patients. *J Psychosoc Oncol* 1998; **16**: 1–20.
- Hann D, Winter K, Jacobsen P. Measurement of depressive symptoms in cancer patients: evaluation of the Center for Epidemiological Studies Depression scale (CES-D). *J Psychosom Res* 1999; **46**: 437–443.
- Pasacrete JV. Depressive phenomena, physical symptom distress, and functional status among women with breast cancer. *Nurs Res* 1997; **46**: 214–221.
- Schover LR, Friedman JM, Weiler SJ, Heiman JR, LoPiccolo J. Multiaxial problem-oriented system for sexual dysfunctions: an alternative to DSM-III. *Arch Gen Psychiatry* 1982; **39**: 614–619.
- Sherbourne CD. Social functioning: sexual problems measures. In: Stewart AL, Ware Jr JE (eds). *Measuring Functioning and Well-Being: The Medical Outcomes Study Approach*. Duke University Press: Durham, NC, 1992, pp 194–204.
- Simmons JS, Carey MP. Prevalence of sexual dysfunctions: results from a decade of research. *Arch Sex Behav* 2001; **30**: 177–219.
- Lee SJ, Joffe S, Kim HT, Socie G, Gilman AL, Wingard JR *et al*. Physicians' attitudes about quality-of-life issues in hematopoietic stem cell transplantation. *Blood* 2004; **104**: 2194–2200.
- Syrjala KL, Langer SL, Abrams JR, Storer BE, Martin PJ. Late effects of hematopoietic cell transplantation among 10-year adult survivors compared with case-matched controls. *J Clin Oncol* 2005; **23**: 6596–6606.