Multiple Sclerosis and Related Disorders 37 (2020) 101467

Contents lists available at ScienceDirect

Multiple Sclerosis and Related Disorders

journal homepage: www.elsevier.com/locate/msard

Original article

Patients' expectations of autologous hematopoietic stem cell transplantation as a treatment for MS

Floriaan G.C.M. De Kleermaeker[a,*], Bernard M.J. Uitdehaag[b], Bob W. van Oosten[b]

[a] Viecuri Medisch Centrum, Department of Neurology, Venlo, The Netherlands
[b] MS Center Amsterdam, Amsterdam UMC, location VUmc, Department of Neurology, Amsterdam, The Netherlands

ARTICLE INFO

Keywords:
Multiple sclerosis
Autologous hematopoietic stem cell transplantation
Expectations
Treatment
Shared-decision making

ABSTRACT

Background: Autologous hematopoietic stem cell transplantation (aHSCT) receives increasing attention as a treatment option for MS. However, as there are no randomized controlled trials comparing aHSCT to best medical treatment as yet, aHSCT is not generally advised and implemented as a treatment option for MS. Neurologists are increasingly faced with patients asking questions regarding aHSCT and seeking commercially offered aHSCT abroad. The aim of this study is to evaluate MS patients' knowledge and expectations of aHSCT and their actual and desired sources of information.

Methods: 137 MS patients visiting the Amsterdam University Medical Center MS clinic, completed a self-developed questionnaire with items on disease history, knowledge about aHSCT, expectations of aHSCT, information sources and the role they assign to their neurologists.

Results: Fifty-four percent is considering aHSCT either now or in the future, especially those who are dissatisfied with current treatment, have a shorter disease duration (≤ 10 years) or are more disabled (EDSS > 3.5). Only 25% report to have sufficient knowledge about aHSCT. Patients mainly use potentially unreliable information sources such as the internet and television, although they prefer information from their neurologist. Half of the patients think aHSCT to be superior to highly effective DMT. Expectations of efficacy in patients interested in aHSCT are significantly higher than in patients not wanting to undergo aHSCT. Only about one third of patients are able to mention at least one side effect.

Conclusion: Many MS patients are considering aHSCT as a treatment option, although they think that they are not well-informed regarding aHSCT. They prefer their neurologist as a source of information. Therefore, neurologists should pro-actively inform their patients about the potential benefits and risks of aHSCT to enable them to choose the best treatment option.

1. Introduction

In the past two decades, numerous studies have been published suggesting efficacy of autologous hematopoietic stem cell transplantation (aHSCT) in the treatment of severe and refractory multiple sclerosis (MS) (Sormani et al., 2017; Atkins et al., 2016; Mancardi et al., 2015; Muraro et al., 2017). Results are promising and therefore aHSCT is gaining attention as a treatment option for MS, not only in scientific literature, but also on television, the internet and in social media. In the Netherlands, aHSCT is generally not advised and implemented as a treatment option for MS, as there are no randomized controlled trials (RCTs) comparing aHSCT to best medical treatment as yet (with the exception of a small phase II trial in which aHSCT is compared with mitoxantrone (Mancardi et al., 2015), and a preliminary study in which a comparison is made with various first and second line DMT (Burt et al., 2019)). This results in some patients going abroad for commercially offered aHSCT, so called "stem cell tourism" (von Wunster et al., 2018).

In daily practice, neurologists, including the authors, not only notice an increasing number of questions regarding aHSCT, but also unrealistic expectations in many patients. For example, there are patients who think that the main objective of stem cell therapy is repair of neural tissue damage and recovery from disabilities. In order to improve counseling MS patients and to contribute to proper shared decision making, neurologists must be aware of patients' expectations of aHSCT and of aspects that are relevant from patients' points of view.

The aim of this study was to evaluate MS patients' expectations of aHSCT and to investigate their actual and desired sources of

* Corresponding author at: Department of Neurology, Viecuri Medisch Centrum Tegelseweg 2105912 BL Venlo, The Netherlands.
E-mail addresses: florisdekleermaeker@gmail.com (F.G.C.M. De Kleermaeker), bmj.uitdehaag@amsterdamumc.nl (B.M.J. Uitdehaag), vanOosten@amsterdamumc.nl (B.W. van Oosten).

https://doi.org/10.1016/j.msard.2019.101467
Received 5 September 2018; Received in revised form 13 August 2019; Accepted 22 October 2019

information. Moreover, we explored the profile of patients who consider undergoing aHSCT.

2. Material and methods

2.1. Patients

Between February and April 2018, we asked patients to complete a questionnaire that we designed for this purpose. We recruited the patients at the outpatient clinic (mainly patients visiting our hospital for a second opinion regarding their diagnosis or treatment plan) and the day care unit (mainly patients on natalizumab treatment), of the MS Center Amsterdam of the Amsterdam University Medical Center. The local Medical Ethics Review Committee (VU Medical Center) granted a waiver of formal approval and informed consent was obtained from each individual before inclusion.

2.2. Questionnaire

A panel of experts was created, consisting of 4 physicians (3 neurologists and 1 resident) who have experience with MS patients. Topics which are of relevance for MS patients according to the clinical experience of these experts were selected by two of them (FDK, BVO). The appropriateness of the topics was discussed by the three authors (FDK, BVO, BU) and subsequently, questions were formulated. After consensus was reached, the questionnaire was critically revised by the fourth expert (JK). The final questionnaire (appendix 1) consists of 44 items (7 open questions, 37 multiple choice questions): 2 on demographics, 11 on disease history and use of DMT, 10 on patients' knowledge about DMT and aHSCT, 9 on information sources used, 6 on patients' personal situations in relation to aHSCT and 6 on patients' expectations of aHSCT.

2.3. Statistical analysis

All statistical analyses were performed using SPSS Statistics 24.0. Descriptive results are presented as total numbers plus percentage and median plus range (in case of values not normally distributed). Chi-square analyses and Fishers' exact test were performed if applicable, in order to compare frequencies between different groups, and p-values lower than 0.05 were considered as statistically significant.

3. Results

Of the 160 patients included, 137 patients returned the questionnaire (response rate 86%). One hundred and thirteen participants (83%) report ever having heard of aHSCT. Results of these patients are used. Baseline characteristics of the patients are shown in Table 1. Median age was 41 (range: 20–66) and 92% had been diagnosed with MS. Another 5% had been diagnosed with "clinically isolated syndrome" or eventually were diagnosed with MS after a second opinion. A total of 66% were treated with disease modifying therapy (DMT).

3.1. Knowledge about MS therapies

Most of the patients (60%) report to be convinced they have at least sufficient knowledge about currently available DMT. In contrast, only 25% report to have sufficient knowledge about aHSCT and none of the patients rate their knowledge as excellent (Fig. 1). Perceived knowledge about aHSCT is significantly worse compared to DMT.

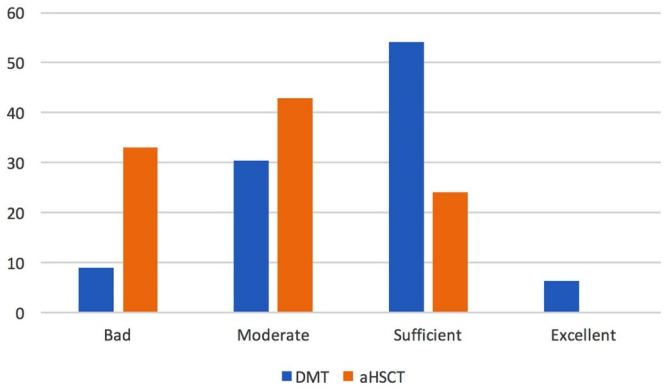
3.2. Effect of aHSCT

The great majority (79%) expect no more disability progression after aHSCT and 46% of the respondents report to expect improvement of disability. About 20% of the patients still expect disability progression, but at a slower pace (Fig. 2A). Moreover, 55% foresee no more relapses after aHSCT and 41% expect that only part of the relapses will be prevented (Fig. 2B). Half of the patients think that aHSCT is more effective than currently available highly effective DMT (alemtuzumab, natalizumab). About 44% indicate that there is insufficient scientific evidence to suppose superiority of aHSCT compared to highly effective DMT (Fig. 2C).

Table 1
Baseline characteristics.

	$N = 113$
Median age in years (range)	41.0 (20–66)
Gender (% female)	75%
Median disease duration in years (range)	8.0 (0–28)
Diagnosis (%)[a]	
• *MS*	104 (2%)
• *Suspected MS*	6 (5%)
MS subtype (%)[a]	
• *RRMS*	84 (74%)
• *SPMS*	10 (9%)
• *PPMS*	9 (8%)
Median estimated EDSS	4.0 (0.0–8.0)
Treatment (%)[a]	
• Alemtuzumab	0 (0%)
• Daclizumab	0 (1%)
• Dimethyl fumarate	9 (8%)
• Fingolimod	6 (5%)
• Glatiramer acetate	6 (5%)
• Interferon beta	0 (3%)
• Natalizumab	47 42%)
• Ocrelizumab	1 (1%)
• Teriflunomide	1 (1%)
• No DMT	35 (31%)

[a] Total < 100% due to missing data.



DMT: disease modifying therapy; aHSCT: autologous hematopoietic stem cell transplantation

Fig. 1. Patients' perception of their level of knowledge concerning DMTs and aHSCT (% of respondents). DMT: disease modifying therapy; aHSCT: autologous hematopoietic stem cell transplantation.

3.3. Side effects of aHSCT

About 52% of the overall sample report that aHSCT has more severe side effects than currently available DMT, 5% think that aHSCT has less severe side effects and 10% that it has comparable side effects. One third of the patients think that side effects are not sufficiently known yet. Only 45% are able to mention at least one of the possible side effects of aHSCT. Increased sensitivity for infections (28%) and death (10%) are reported the most.

3.4. Information about aHSCT

As illustrated in Fig. 3, the majority of the participants (70%)

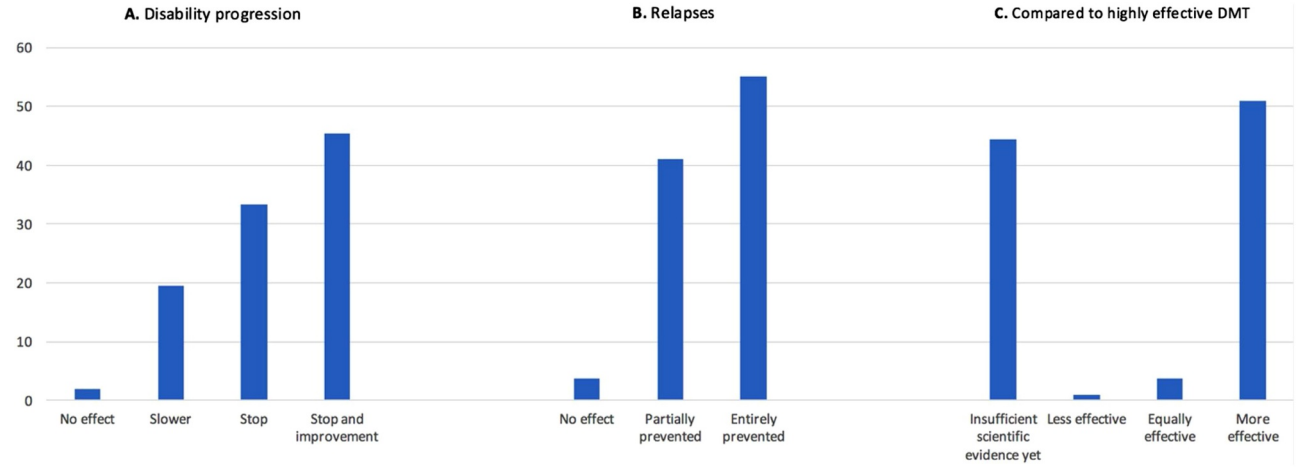


Fig. 2. Patients' opinions about the effect of aHSCT (A) on disability progression, (B) on relapses and (C) compared to highly effective DMT such as natalizumab or alemtuzumab (% of respondents).

indicate that they need more information about aHSCT. Almost one quarter of those surveyed report to actively seek information. Participants who are dissatisfied with their current treatment as well as more disabled patients (EDSS > 3.5) are more likely to indicate that they need information than satisfied (100%% vs 79.2%) and less disabled patients (EDSS ≤ 3.5, 93.2%% vs 76.7%). Moreover, they also seek information more actively (52.9%% vs 16.7% and 35.8%% vs 17.5%, respectively).

Sources of information that patients mainly use are the internet (informative websites 74%, patient forums 36%) and television (55%). However, only 15% believe that informative websites are reliable; and patient forums and television are seen as credible sources of information to an even lesser extent (4% and 2%, respectively). When we asked the participants which sources of information they trust the most, 81% mention their neurologist, 58% an experience expert and 49% mention scientific literature (Fig. 4).

3.5. Personal situation

Just over half of the participants (56%) indicate to be satisfied with their current treatment, and a minority of the participants (18%) claim to be dissatisfied. When asked whether they want aHSCT at this moment, 19% answer positively. Moreover, a total of 54% say to consider aHSCT as a future treatment. Almost 80% believe that advice of their neurologist is not influenced by the pharmaceutical industry. More details are presented in Fig. 3.

3.6. Patients who want to undergo aHSCT now or perhaps in future

Patients with a shorter disease duration (≤10 years), more disability (EDSS > 3.5) and dissatisfaction with current treatment are more likely to want aHSCT at this moment or possibly in the future. However, only 38% of those indicate to have sufficient knowledge of aHSCT. Patients considering aHSCT had significantly higher expectations of aHSCT than patients not willing to undergo aHSCT, but only a minority (37%) is able to mention at least one side effect. About one fifth of the patients currently intending to undergo aHSCT, report that possible side effects of aHSCT are less severe than of DMT, which is significantly more than in patients not willing to undergo aHSCT at this moment. More details are presented in Table 2.

4. Discussion

Though MS patients indicate not to have sufficient knowledge about aHSCT, expectations are high. Patients seek information actively in easily available sources, even though many of them are aware that

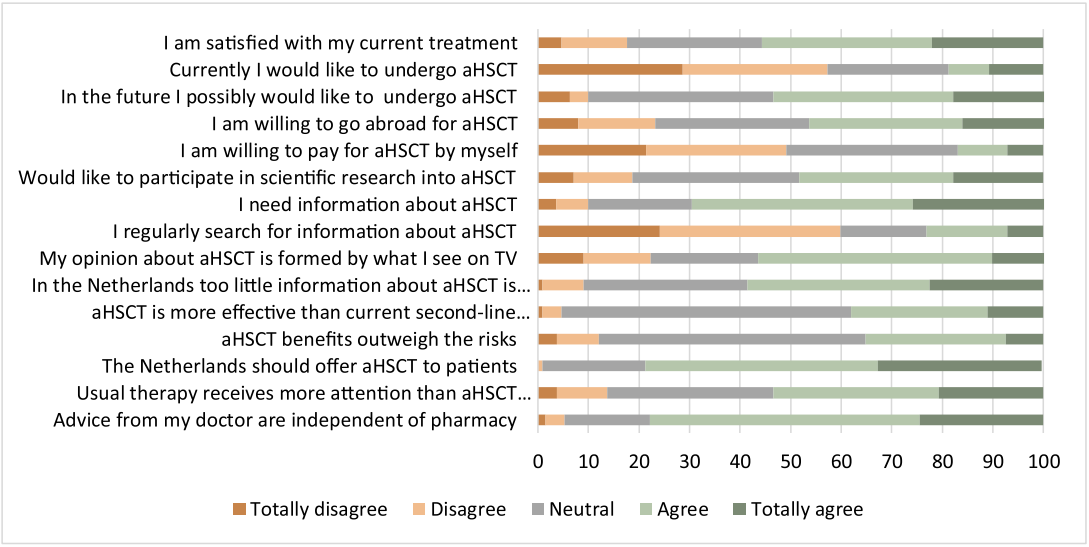


Fig. 3. Patients' opinions about different aspects of aHSCT (%).

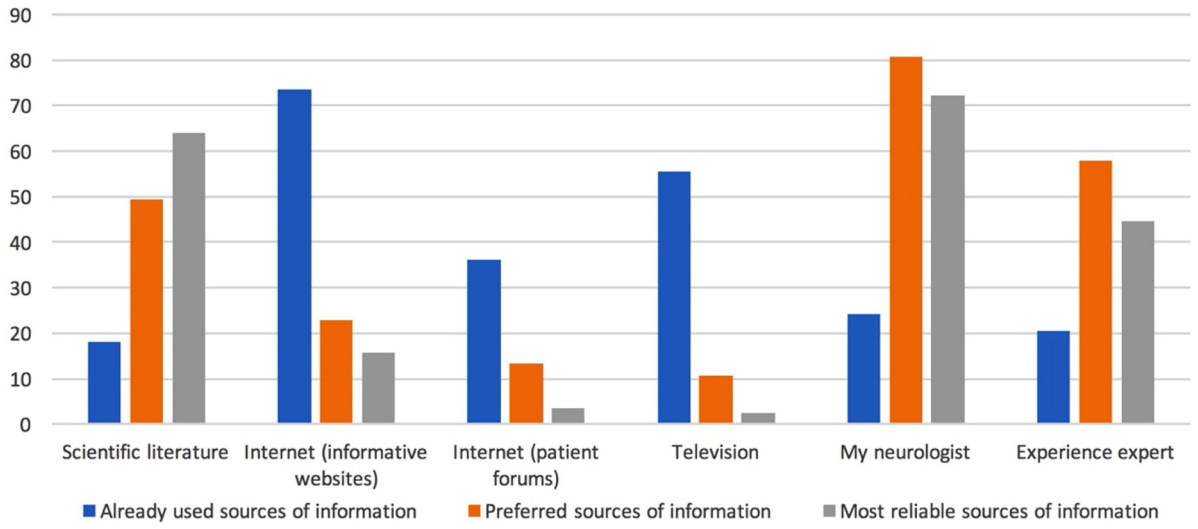


Fig. 4. Information sources used by patients to gain information about aHSCT (% of respondents).

these are not reliable. Patients indicate they need more information, preferably from their own neurologist. Especially patients dissatisfied with their current treatment, shorter disease duration and patients with higher EDSS are willing to undergo aHSCT now or in the future. Expectations about efficacy in patients interested in aHSCT are significantly higher than patients not wanting to undergo aHSCT. Strikingly, only the minority of those patients have knowledge of the potential risks of aHSCT.

No previous data are available about patients' expectations of aHSCT in MS. Given the often unpredictable course of this lifelong disease and the high prevalence of anxiety in MS patients, it is not surprising that patients consider experimental therapies (Tauil et al., 2018). Direct-to-consumer online advertising of aHSCT and accessibility of information on the internet have increased patient demand for this therapy. In a previous study, it was stated that MS patients often consciously avoid negative information and look for positivity (Dennison et al., 2016). This can lead to patients receiving biased information from media that uncritically report statements about efficacy, which can lead to misinterpretations. Subsequently, such articles are cited in social media and used in crowd-funding efforts, which may further consolidate public expectations and arouse patients' curiosity (von Wunster et al., 2018; Sipp et al., 2017). This concern was supported by our study, in which the internet and television appear to be the most used information sources. In accordance with a previous study, patients assigned their neurologist as the most desired source of information (Visser et al., 2016). Therefore, neurologists should actively inform patients about aHSCT to put information gathered from unreliable sources in a realistic perspective and prevent unrealistic expectations.

Most of the patients expect no more progression of disability (or even improvement of EDSS) and no more relapses after aHSCT, especially those who consider aHSCT now or in the future. Indeed, results of studies in the field of aHSCT as treatment for MS are promising. Different studies report significant attenuation of disability progression or even lower mean EDSS, reduction of annualized relapse rate and proportion of "no evidence of disease activity" (NEDA) (Sormani et al., 2017; Atkins et al., 2016; Mancardi et al., 2015; Muraro et al., 2017). However, all those studies have major limitations (small population, single arm, short follow-up, heterogeneity in study population and aHSCT regime) and results of well-designed RCTs comparing aHSCT to best medical treatment are not available. In addition, there are significant risks for morbidity and mortality (von Wunster et al., 2018; Burman and Fox, 2017). Therefore, aHSCT is currently recommended in the context of properly regulated clinical trials only.

Patients interested in aHSCT have a higher EDSS, shorter disease duration and are more often dissatisfied with current treatment than people not willing to undergo aHSCT. Those patients have higher expectations of aHSCT and more often actively seek information about aHSCT from unreliable sources. Patients who would like to undergo aHSCT now or in the future, underestimate possible risks and only about one third is able to mention at least one side effect. Therefore, this category of patients in particular should get the attention of the neurologist.

Our study has several limitations. Firstly, we used a questionnaire, designed by us for this purpose. Although selection of questions was done accurately by a panel of 4 experts, the questionnaire was not formally validated beyond face validity. Secondly, data on disease history was self-reported by patients and not checked in medical records. Therefore, these data are susceptible to inaccuracies. Moreover, many participants were treated with second line treatment (especially natalizumab). This can theoretically have biased the results, as these patients generally have more active MS, see many other patients during their four-weekly infusions and are therefore probably better informed about different treatment options. However, there were no differences in supposed knowledge about aHSCT, its effectiveness and supposed side effects compared to patients not using second line DMT (data not shown). Therefore, bias may be limited. Furthermore, our sample of patients is probably not very representative of the general MS population. For example, patients with severe MS residing in nursing homes are not represented. Nevertheless, we believe that the general results of this study are of interest for doctors treating patients with MS.

5. Conclusion

We have found that expectations of aHSCT in MS patient are high, even though many patients indicate not to have sufficient knowledge about aHSCT and to use unreliable information sources. It is important for the treating neurologist to realize that patients who are dissatisfied with their current treatment, have a shorter disease duration and higher EDSS are more likely to consider aHSCT either now or in the future.

The fact that inadequate information can lead to premature conclusions and decisions, is clearly illustrated by our observation that the patients who want to undergo aHSCT are more likely to assume superiority of aHSCT to DMT, though solid scientific evidence is scarce yet and has limitations. Moreover, they are not sufficiently aware of potential risks of this treatment. Although there certainly is an impact of mass media and social media, our study indicates that most patients consider their neurologist as the most trusted source of information.

Table 2
Subgroup analyses for patients who do or do not want to undergo aHSCT (now or in the future).

	Patients willing to undergo aHSCT		*p*
	Yes	No	
Gender			
• Woman	42(70%)	33 (77%)	0.448
• Man	18 (30%)	10 (23%)	
Disease duration			
• ≤ 10 years	41 (72%)	19 (49%)	**0.021**
• > 10 years	16 (28%)	20 (51%)	
EDSS			
• ≤3.5	19 (32%)	24 (56%)	**0.014**
• > 3.5	41 (68%)	19 (44%)	
DMT			
• No	21 (36%)	10 (24%)	0.206
• Yes	38 (64%)	32 (76%)	
DMT			
• First line	12 (32%)	9 (28%)	0.753
• Second line	26 (68%)	23 (72%)	
Perceived knowledge about aHSCT			
• Insufficient	36 (62%)	37 (88%)	**0.004**
• Sufficient	22 (38%)	5 (12%)	
Supposed effect aHSCT on relapses			
• No effect	1 (2%)	3 (7%)	**0.024**
• Partially prevented	20 (34%)	22 (54%)	
• No more relapses	38 (64%)	16 (39%)	
Supposed effect aHSCT on disability progression			
• No effect	1 (2%)	1 (3%)	**0.006**
• Slower	7 (12%)	14 (35%)	
• Stop	18 (30%)	14 (35%)	
• Stop and improvement	34 (56%)	11 (27%)	
Supposed effect aHSCT compared to DMT			
• More effective	39 (66%)	9 (23%)	< **0.001**
• Less effective	1 (2%)	0 (0%)	
• Equally effective	1 (2%)	2 (5%)	
• Unknown yet	17 (29%)	29 (72%)	
Knowledge of at least 1 side effect of aHSCT			
• No	38 (63%)	21 (49%)	0.142
• Yes	22 (37%)	22 (51%)	
Severity of side effect aHSCT compared to DMT			
• More severe	29 (49%)	24 (57%)	0.274
• Less severe	5 (9%)	0 (0%)	
• Equal	6 (10%)	3 (7%)	
• Unknown yet	19 (32%)	15 (36%)	
Actively searching for information			
• No	7 (12%)	20 (47%)	< **0.001**
• Yes	53 (88%)	23 (53%)	
Sources of information used*			
• Scientific research	10 (17%)	5 (12%)	0.475
• Internet (informative websites)	40 (67%)	17 (40%)	**0.006**
• Internet (patient forums)	20 (33%)	7 (16%)	0.052
• Television	35 (58%)	11 (26%)	**0.001**
• My neurologist	18 (30%)	1 (2%)	< **0.001**
• Experience expert	13(22%)	2 (5%)	**0.016**
Need for more information			
• No	2 (4%)	9 (30%)	**0.001**
• Yes	52 (96%)	21 (70%)	
Satisfied with current treatment			
• No	17 (38%)	1 (3%)	< **0.001**
• Yes	28 (62%)	30 (97%)	
Supposed independency of neurologist from pharmaceutical industries			
• No	3 (6%)	1 (3%)	0.625
• Yes	43 (94%)	36 (97%)	

* Only patients who stated to actively seek for information about aHSCT are included. Patients were allowed to give 4 answers, so total percentage is not equal to 100%. Number of patients varies due to missing values.

Therefore, we think that neurologists would do well to pro-actively inform their patients about the potential benefits and risks of aHSCT, as compared to currently approved treatments, to prevent injudicious decisions in MS patients. In our opinion, it would not be prudent to leave the initiative to others, including those with commercial interests.

Declaration of Competing Interest

The author(s) declared the following potential conflicts of interest with respect to the research, author- ship and/or publication of this article: F.D.K. and B.V.O had nothing to disclose. B.U reports personal fees from Genzyme, personal fees from Biogen Idec, personal fees from TEVA, personal fees from Merck Serono, personal fees from Roche, outside the submitted work.

Acknowledgements

The authors thank Joep Killestein (JK) for his critical revision and for important intellectual content of our questionnaire.

Funding

This research received no specific grant from any funding agencies in the public, commercial, or not-for-profit sectors.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.msard.2019.101467.

References

Sormani, M.P., Muraro, P.A., Schiavetti, I., Signori, A., Laroni, A., Saccardi, R., Mancardi, G.L., 2017. Autologous hematopoietic stem cell transplantation in multiple sclerosis: a meta-analysis. Neurology 88 (22), 2115–2122. https://doi.org/10.1212/WNL.0000000000003987.

Atkins, H.L., Bowman, M., Allan, D., Anstee, G., Arnold, D.L., Bar-Or, A., Bence-Bruckler, I., Birch, P., Bredeson, C., Chen, J., Fergusson, D., Halpenny, M., Hamelin, L., Huebsch, L., Hutton, B., Laneuville, P., Lapierre, Y., Lee, H., Martin, L., McDiarmid, S., O'Connor, P., Ramsay, T., Sabloff, M., Walker, L., Freedman, M.S., 2016. Immunoablation and autologous haemopoietic stem-cell transplantation for aggressive multiple sclerosis: a multicentre single-group phase 2 trial. Lancet 388 (10044), 576–585. https://doi.org/10.1016/S0140-6736(16)30169-6.

Mancardi, G.L., Sormani, M.P., Gualandi, F., Saiz, A., Carreras, E., Merelli, E., Donelli, A., Lugaresi, A., Di Bartolomeo, P., Rottoli, M.R., Rambaldi, A., Amato, M.P., Massacesi, L., Di Gioia, M., Vuolo, L., Curro, D., Roccatagliata, L., Filippi, M., Aguglia, U., Iacopino, P., Farge, D., Saccardi, R., Astims Haemato-Neurological Collaborative Group ObotADWPotEGfB, Marrow T, Blood AH-NCGObotADWPAotEGf, Marrow Transplantation E, 2015. Autologous hematopoietic stem cell transplantation in multiple sclerosis: a phase II trial. Neurology 84 (10), 981–988. https://doi.org/10.1212/WNL.0000000000001329.

Muraro, P.A., Pasquini, M., Atkins, H.L., Bowen, J.D., Farge, D., Fassas, A., Freedman, M.S., Georges, G.E., Gualandi, F., Hamerschlak, N., Havrdova, E., Kimiskidis, V.K., Kozak, T., Mancardi, G.L., Massacesi, L., Moraes, D.A., Nash, R.A., Pavletic, S., Ouyang, J., Rovira, M., Saiz, A., Zhu, L., Badoglio, M., Zhong, X., Sormani, M.P., Saccardi, R., Multiple Sclerosis-Autologous Hematopoietic Stem Cell Transplantation Long-term Outcomes Study G, ., 2017. Long-term outcomes after autologous hematopoietic stem cell transplantation for multiple sclerosis. JAMA Neurol. 74 (4), 459–469. https://doi.org/10.1001/jamaneurol.2016.5867.

Burt, R.K., Balabanov, R., Burman, J., Sharrack, B., Snowden, J.A., Oliveira, M.C., Fagius, J., Rose, J., Nelson, F., Barreira, A.A., Carlson, K., Han, X., Moraes, D., Morgan, A., Quigley, K., Yaung, K., Buckley, R., Alldredge, C., Clendenan, A., Calvario, M.A., Henry, J., Jovanovic, B., Helenowski, I.B., 2019. Effect of nonmyeloablative hematopoietic stem cell transplantation vs continued disease-modifying therapy on disease progression in patients with relapsing-remitting multiple sclerosis: a randomized clinical trial. JAMA 321 (2), 165–174. https://doi.org/10.1001/jama.2018.18743.

von Wunster, B., Bailey, S., Wilkins, A., Marks, D.I., Scolding, N.J., Rice, C.M., 2018. Advising patients seeking stem cell interventions for multiple sclerosis. Pract. Neurol. https://doi.org/10.1136/practneurol-2018-001956.

Tauil, C.B., Grippe, T.C., Dias, R.M., Dias-Carneiro, R.P.C., Carneiro, N.M., Aguilar, A.C.R., Silva, F.M.D., Bezerra, F., Almeida, L.K., Massarente, V.L., Giovannelli, E.C., Tilbery, C.P., Brandao, C.O., Santos, L.M.B., Santos-Neto, L.D., 2018. Suicidal ideation, anxiety, and depression in patients with multiple sclerosis. Arq. Neuropsiquiatr.

76 (5), 296–301. https://doi.org/10.1590/0004-282X20180036.
Dennison, L., McCloy Smith, E., Bradbury, K., Galea, I., 2016. How do people with multiple sclerosis experience prognostic uncertainty and prognosis communication? a qualitative study. PLoS ONE 11 (7), e0158982. https://doi.org/10.1371/journal.pone.0158982.
Sipp, D., Caulfield, T., Kaye, J., Barfoot, J., Blackburn, C., Chan, S., De Luca, M., Kent, A., McCabe, C., Munsie, M., Sleeboom-Faulkner, M., Sugarman, J., van Zimmeren, E., Zarzeczny, A., Rasko, J.E.J., 2017. Marketing of unproven stem cell-based interventions: a call to action. Sci. Transl. Med. 9 (397). https://doi.org/10.1126/scitranslmed.aag0426.
Visser, L.H., Heerings, M.A., Jongen, P.J., van der Hiele, K., 2016. Perspectives and experiences of Dutch multiple sclerosis patients and multiple sclerosis-specialized neurologists on injectable disease-modifying treatment. Patient Prefer. Adherence. 10, 659–667. https://doi.org/10.2147/PPA.S106155.
Burman, J., Fox, R.J., 2017. Autologous hematopoietic stem cell transplantation for MS: safer than previously thought. Neurology 88 (22), 2072–2073. https://doi.org/10.1212/WNL.0000000000003995.