Leukemia Research 129 (2023) 107074

Contents lists available at ScienceDirect

Leukemia Research

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

Analysis of patient-reported experiences up to 2 years after receiving idecabtagene vicleucel (ide-cel, bb2121) for relapsed or refractory multiple myeloma: Longitudinal findings from the phase 2 KarMMa trial

Michel Delforge [a,*], Paula Rodríguez Otero [b], Nina Shah [c], Olga Moshkovich [d], Julia Braverman [e], Devender S. Dhanda [e], Sally Lanar [f], Jennifer Devlen [g], Matthew Miera [g], Heather Gerould [g], Timothy B. Campbell [e], Nikhil C. Munshi [h]

[a] University Hospital Leuven, Leuven, Belgium
[b] Clínica Universidad de Navarra, Pamplona, Spain
[c] UCSF Medical Center, San Francisco, CA, USA
[d] ICON plc, San Francisco, CA, USA
[e] Bristol Myers Squibb, Princeton, NJ, USA
[f] ICON plc, Lyon, France
[g] ICON plc, Gaithersburg, MD, USA
[h] Jerome Lipper Multiple Myeloma Center, Dana-Farber Cancer Institute, and Boston VA Healthcare System, Harvard Medical School, Boston, MA, USA

ARTICLE INFO

Keywords:
Relapsed or refractory multiple myeloma
Triple-class exposed
Idecabtagene vicleucel
CAR T cell therapy
Patient-reported outcomes
Patient experience

ABSTRACT

Objective: To understand the long-term experience of patients receiving ide-cel chimeric antigen receptor T (CAR T) cell therapy for relapsed or refractory multiple myeloma in the pivotal phase 2 KarMMa trial.
Methods: This qualitative study analyzed semi-structured patient interviews 6–24 months after ide-cel infusion. Thematic analysis with quantitative and longitudinal analyses explored patient perceptions of ide-cel treatment experience, advantages and disadvantages, and long-term health-related quality of life impact. Patient journeys were developed from narrative analysis of perceived treatment benefits with known remission length.
Results: Interviews with 45 patients 6–24 months postinfusion were analyzed; all reported ≥ 1 ide-cel treatment advantage, most often related to efficacy (n = 42/45, 93%), few or no side effects (n = 35/45, 78%), and avoidance of other treatments (n = 34/45, 76%). Patients generally reported 6-month improvements in physical health, functioning, emotional well-being, social life, and outlook on the future; these improvements mostly remained "stable" through 18 and 24 months. The most common patient journeys comprised physical, functioning, or emotional benefit with remission < 2 years.
Conclusions: Longitudinal analysis of patient experiences showed sustained benefits and preference for ide-cel up to 24 months after treatment.
Trial Registration Number and Date: NCT03361748. December 5, 2017.

1. Introduction

Adults with relapsed or refractory multiple myeloma (RRMM) who have received an immunomodulatory agent, a proteasome inhibitor, and anti-CD38 antibody, considered to be "triple-class exposed" (TCE), have poor prognoses and limited treatments [1–4]. Later treatment lines aimed at reducing recurrence are associated with substantial pain and fatigue, with a detrimental effect on health-related quality of life (HRQoL) [5,6].

Idecabtagene vicleucel (ide-cel, bb2121) is a B-cell maturation agent-directed CAR T cell therapy that has shown frequent, deep, and durable responses in patients with TCE RRMM in the pivotal, single-arm, phase 2 KarMMa trial [7]. Long-term follow-up results from the KarMMa trial (median 24.8 months follow-up, data cutoff December 21, 2020) showed a 73% overall response rate (ORR) and median progression-free survival (PFS) of 8.6 months in all treated patients [8]. Those who received the highest target dose (450 × 10^6 CAR+ T cells) had an 81% ORR, 39% complete response rate, and a median PFS of 12.2 months [8].

* Correspondence to: University Hospital Leuven, Herestraat 49, 3000 Leuven, Belgium.
E-mail address: michel.delforge@uzleuven.de (M. Delforge).

https://doi.org/10.1016/j.leukres.2023.107074
Received 25 January 2023; Received in revised form 20 March 2023; Accepted 2 April 2023
Available online 3 April 2023

Ide-cel also showed statistically significant clinically meaningful improvements in HRQoL domains for pain and physical functioning 1 month after treatment, and fatigue, cognitive functioning, and global health status/HRQoL by month 2 [9]. For fatigue, pain, and physical functioning these improvements were generally maintained through 18 months after the ide-cel infusion [9]. Cognitive functioning remained stable through 9 months, while improvements in disease symptoms were observed between 3 and 15 months after ide-cel treatment [9].

In-depth patient interviews were embedded into the KarMMa trial to understand the patient experience beyond established patient-reported outcome instruments. Incorporating the patient voice from qualitative interviews facilitates a more holistic understanding of the patient experience before, during, and after treatment. An interim report based on interviews pre ide-cel treatment and up to 3 months after receiving ide-cel showed patient-reported improvements in physical health and functioning, an improved outlook for the future, and an overall favorable impression of the treatment experience [10]. This study reports longer-term patient experience data from postinfusion interviews conducted 6–24 months after ide-cel treatment in the KarMMa trial.

2. Materials and methods

2.1. The KarMMa trial

The design and clinical outcomes from the KarMMa trial (NCT03361748) were reported previously [7,8], as have HRQoL findings from 126 of 128 (98%) eligible patients [9]. Patients with TCE RRMM who received $\geq$ 3 prior antimyeloma regimens and were refractory to their last regimen based on International Myeloma Working Group (IMWG) criteria were enrolled [7,11]; 128/140 (91%) eligible patients received leukapheresis and a single ide-cel infusion [7].

The phase 2 KarMMa clinical trial (NCT03361748) was conducted in accordance with the International Council for Harmonisation guidelines and the principles of the Declaration of Helsinki. The study protocol and associated amendments were approved by local or independent institutional review boards or ethics committees at participating sites. All patients provided written informed consent.

2.2. Patient interviews embedded in the KarMMa trial

Patients participated in up to 11 voluntary, semi-structured interviews from screening up to 24 months after ide-cel infusion. Methods and findings from interviews conducted before leukapheresis and from monthly interviews up to 3 months after ide-cel infusion were reported previously [10].

This study reports findings from postinfusion interviews conducted 6, 9, 12, 18, and 24 months after the ide-cel infusion. Interviews for months 6–24 took place between October 8, 2018 and December 18, 2020. The interview schedule is provided in Appendix Figure A.1. All interviews were guided by professional qualitative researchers from a contract research organization (CRO); ICON plc (Dublin, Ireland; www.iconplc.com) or subcontractors trained by the CRO. Some study sites and countries imposed limitations on patient interviews conducted by third-party research organizations; therefore, not all patients from all sites could participate. The interview guides are provided in Appendix B. Interviews were $\leq$ 1 h long and performed in the patient's preferred language in person or by telephone. Transcripts of the recorded interviews were translated into English, and coded and analyzed by 4 analysts using MAXQDA qualitative analysis software (VERBI GmbH, Berlin, Germany). Assessments of inter-analyst agreement were performed to ensure sufficient reliability.

The interviews were semi-structured. Thus, patients were not always asked every question and did not always provide responses according to a prespecified scale. Interviews included open-ended and close-ended questions. For open-ended questions, a thematic, cross-sectional analysis was conducted for multiple objectives to summarize data across time points. Objectives included: (1) patients' perceptions of the ide-cel treatment experience, including feelings about the infusion experience and the postinfusion period; (2) perceived (not physician-diagnosed) side effects of treatment; (3) identification of relevant symptoms and their impacts; and (4) other concepts relevant to patient-reported well-being.

The close-ended questions included: (1) whether or not patients would choose ide-cel again ("Knowing what you know now, would you make the same decision to receive [ide-cel] therapy?"; with response options "Yes", "No", or "Not sure"); (2) if they would recommend ide-cel to a friend ("If a friend was in a similar situation, faced with the same decision, and asked you for advice, what advice would you give?"; with response options "Strongly recommend", "Somewhat recommend", or "Not recommend"); (3) rating of treatment benefits and of negative aspects on a 0–10 scale (where 0 indicated "none" and 10 indicated "tremendous benefits" or "tremendous negative aspects"); and (4) whether benefits outweighed negative aspects on a 5-point Likert scale ranging from "benefits greatly outweighed negatives" to "negatives greatly outweighed benefits".

If patients were unsure how to answer a close-ended question, or misunderstood the direction of the scale, the response was coded as "unclear". If an interviewer did not ask the question during the interview, the lack of a response was coded as "missing". If a patient changed their mind during the interview and provided $>$ 1 answer to a close-ended question, the latest response was coded. When the responses to close-ended questions were on a numerical scale, if a patient gave a decimal response to a numeric rating scale (e.g., 9.5 on a scale from 0 to 10), the response was used as provided to calculate mean, standard deviation (SD), and frequency, but was rounded down to the nearest integer for the reporting of frequencies.

2.3. Perceived advantages and disadvantages of ide-cel treatment

Perceived advantages and disadvantages of ide-cel treatment 6–24 months postinfusion were explored using both thematic analysis of open-ended questions and quantitative analysis of close-ended questions.

2.4. Longitudinal well-being and the patient journey

Postinfusion interviews also explored longitudinal changes in well-being up to 2 years after ide-cel infusion and the overall patient journey with ide-cel treatment. Patients with RRMM who did not respond to ide-cel or relapsed may have received another treatment during the postinfusion period and continued to participate in interviews while receiving another treatment. Descriptions of changes in well-being provided by patients receiving ide-cel and those receiving another treatment were analyzed together; no distinction was made based on what treatment the patient was receiving at the time of the interviews.

Patients were asked about their general health and well-being at each interview time point with specific questions about their physical health (patient's description of their overall physical symptoms and the overall feeling in their body), physical functioning in daily activities, emotional well-being, social life/leisure activities, employment/professional life, finances, and outlook on the future. Analysts categorized these domains as "improved", "worsened", or "stable" by comparing patient descriptions from the pre-infusion baseline interview with responses from the interview at the previous time point. Results are presented for postinfusion time points of 6, 12, and 24 months.

Patient narratives were developed based on representative patterns uncovered in the interviews using the same methodology as the interim report [10]. Briefly, based on their subsample of patients, each researcher assessed potential aspects of the patient experience, and how patients might be grouped within them. The research team collectively discerned similarities and differences to classify patients and reach

consensus. The final aspects and groups were defined with input and review from the research team to classify each patient into one group per aspect. The distribution of patients across groups and aspects was reviewed to identify the most common patient journeys and describe them. The narrative analysis considered the patient's self-reported length of remission from the first ide-cel infusion (although some patients received a second ide-cel infusion, remission length in this analysis was limited to the first infusion), which was grouped as "up to 1 year", "more than 1 year", "at least 24 months", or "unclear" for those that were not apparent.

3. Results

3.1. Postinfusion interview sample

A total of 131 postinfusion interviews were analyzed from 45 unique patients from 6 to 24 months after ide-cel infusion (35% of the 128 patients who received ide-cel). Most patients were from the United States (n = 31, 69%), followed by France (n = 6, 13%), Spain (n = 5, 11%), Italy (n = 2, 4%), and Germany (n = 1, 2%;). Completion of interviews declined over the long-term follow-up period from month 6 (n = 36) to months 9 (n = 32), 12 (n = 23), 18 (n = 21), and 24 (n = 19). The mean age of patients at the time of informed consent for study participation was 63.5 years (SD: 8.7 years), and approximately half were men (56%, n = 25).

3.2. Perceived advantages of ide-cel treatment

Six overarching themes around advantages were observed (Fig. 1), with all patients (n = 45) reporting ≥ 1 advantage of ide-cel treatment. Most common advantages were related to efficacy (n = 42/45, 93%), having few or no side effects (n = 35/45, 78%), and the avoidance of other treatments such as chemotherapy (n = 34/45, 76%).

3.2.1. Efficacy and well-being

"[...] I've been in remission for, what, a year and a half. Well I feel very lucky and fortunate."

Most patients (n = 42/45, 93%) said the efficacy benefit of ide-cel was an advantage. Efficacy was most commonly described in terms of general satisfaction with the treatment response (n = 34/45, 76%). Patients also reported an efficacy advantage of ide-cel treatment despite having relapsed at the time of their interview (n = 10/45, 22%). Over half of the patients considered the potency or durability of their clinical response to be an advantage of ide-cel (n = 23/45, 51%). For example, patients described their response to ide-cel treatment as having "staying power", being "automatic and lasting", or that it had been "the longest remission I've had from any treatment".

Approximately half of the patients expressed advantages regarding improved well-being (n = 23/45, 51%), often citing physical benefits including having "no pain related to myeloma" or "getting my energy, my body back". Other patients reported improvements in their social lives, emotional status, or professional lives.

3.2.2. Minimal or lack of side effects

"Well, it's probably the most effective with the least amount of side effects of any other treatment that I've had."

The second most common advantage of ide-cel was a minimum or lack of perceived side effects (n = 35/45, 78%). Approximately half of these patients highlighted the lack of lingering side effects (n = 17/45, 38%), and were happy not having side effects 6–24 months postinfusion regardless of any side effects experienced at earlier time points in the trial. Several patients reported a quick recovery time after ide-cel infusion (n = 6/45, 13%), with recovery faster than previous treatments.

3.2.3. Avoidance of other treatments

"And then the other super main [advantage] is that there's no maintenance; chemo, drugs, infusions, going to the hospital back and forth."

Most patients expressed an advantage of ide-cel as avoiding other treatments or maintenance therapies (n = 34/45, 76%). These comments cited avoidance of chemotherapy (n = 23/45, 51%) or other treatments (n = 21/45, 47%), most often for reasons related to perceived side effects (Table 1). Patients cited the importance of avoiding difficult or ineffective one-time procedures and/or debilitating prolonged maintenance therapies.

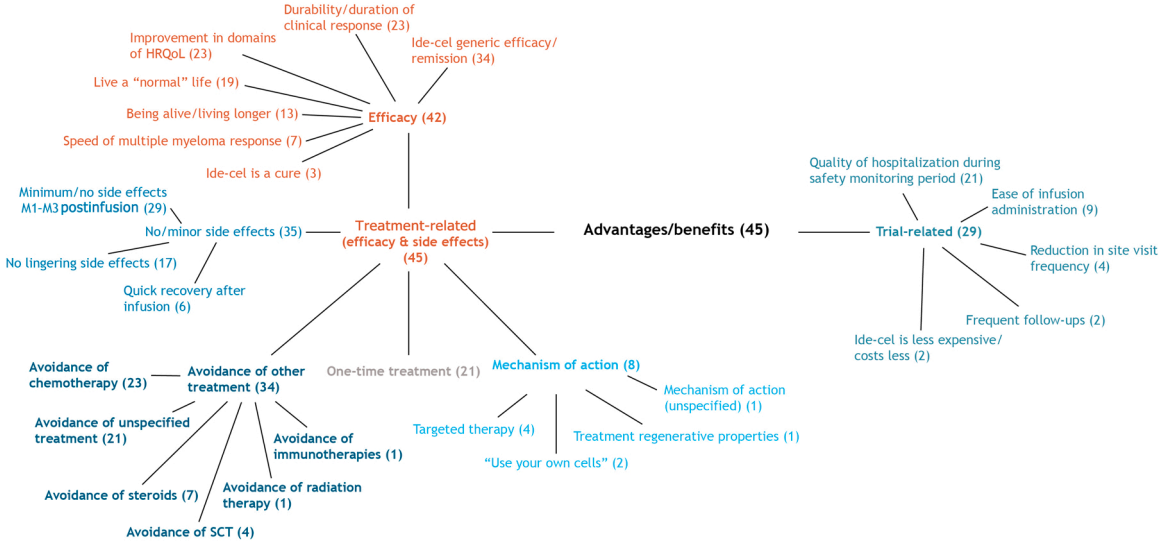

Fig. 1. Perceived advantages of ide-cel treatment through 24 months postinfusion. Numbers in parentheses are the number of patients who mentioned the concept in ≥ 1 of their interviews. HRQoL, health-related quality of life; M, month; SCT, stem cell transplantation.

Table 1
Patients' comments reporting advantages of ide-cel to avoid other treatments, with reasons.

Reasons	Chemotherapy, *n*	Other treatments, *n*	Steroids, *n*	SCT, *n*	Radiation, *n*	Immunotherapy, *n*
Advantages of ide-cel (total)[a]	23	21	7	4	1	1
Side effects	15	13	6	3	-	1
Specific reason unknown	13	11	3	1	1	-
Time	8	13	2	-	-	-
Cost	3	3	-	-	-	-

n, number of comments; SCT, stem cell transplantation.
[a] Patients' comments that mentioned ≥ 1 of the reasons below as an advantage of ide-cel over other treatments.

3.3. Perceived disadvantages of ide-cel treatment

Most patients self-reported ≥ 1 disadvantage of ide-cel treatment (*n* = 41/45, 91%), most often related to perceived side effects postinfusion (*n* = 27/45, 60%), lack of efficacy (*n* = 23/45, 51%), and lingering or persistent side effects still present at month 6 onward (*n* = 18/45, 40%) (Fig. 2). Many patients identified disadvantages related to the trial (*n* = 31/45, 69%), mostly concerning postinfusion monitoring processes (*n* = 24/45, 53%).

3.3.1. Side effects after infusion

"[…] the only bad parts of it were the risk associated with the actual infusion, I think it's called … Cytokine release syndrome. The risk of that."

Twenty-seven of the 41 patients reporting any disadvantages of ide-cel reported disadvantages related to side effects; most were mild to moderate (*n* = 10/45, 22%) or severe (*n* = 19/45, 42%) side effects that occurred in the 1–3 months following the infusion. Patients reporting severe side effects often cited fever, occasionally leading to chills or shaking, or infection. Mild or moderate side effects were mostly less significant: fever, a bad case of the flu, pain, hair loss, a temporarily damaged immune system, and fatigue.

3.3.2. Lack of efficacy

"I had a life, but only for two, three months then, not comparable with the one of the last few years and now it's all taken away from me again."

Approximately half of patients reported disadvantages related to lack of efficacy (*n* = 23/45, 51%), most of which were related to duration of treatment response (*n* = 16/45, 36%). Several patients considered their treatment response to be insufficient or that they did not respond to treatment at all (*n* = 7/45, 16%).

3.3.3. Lingering or persistent side effects present from 6 months postinfusion onward

"The only disadvantage is that the immune defenses diminish."

Fewer than half of patients reported disadvantages of ide-cel related to lingering or persistent side effects (*n* = 18/45, 40%), defined as those experienced 6–24 months postinfusion. The most common lingering side effect was a weakened immune system, which varied in severity from "*insignificant*" to "*more so than what I expected*" and were minor or moderate. Few patients experienced severe side effects 6 months post-infusion (residual bone pain from fractures during the trial, *n* = 1) and 12 months postinfusion (atrial fibrillation, *n* = 1).

3.4. Longitudinal perspectives on ide-cel treatment concepts

Patients reported more advantages than disadvantages of ide-cel treatment 6–24 months postinfusion. The efficacy advantage of ide-cel was prominent over the long-term follow-up period. Perceived advantages of ide-cel related to minimal side effects, being able to live a normal life, and avoidance of other treatments increased in prominence over time, as did the perceived disadvantage of a short treatment response for some patients (Fig. 3).

3.4.1. Close-ended assessments of advantages and disadvantages of ide-cel treatment

When patients were asked to weigh the benefits and negative aspects of ide-cel, > 70% reported a benefit score of 8–10/10 at each time point. Mean scores of benefits ranged from 8.7/10 (SD, 2.62) at month 9 to 7.8/10 (SD, 3.71) at month 18. Low scores of benefits (0–4/10) were given by 2–4 patients who had relapsed or did not achieve remission across time points. Negative aspects were consistently rated on the low end of the scale, as mean scores ranged from 1.9/10 (SD, 1.89) at month 12 to 2.7/10 (SD, 2.41) at month 9. Most common response across all interviews was no negative aspects (0/10). Few patients rated negative

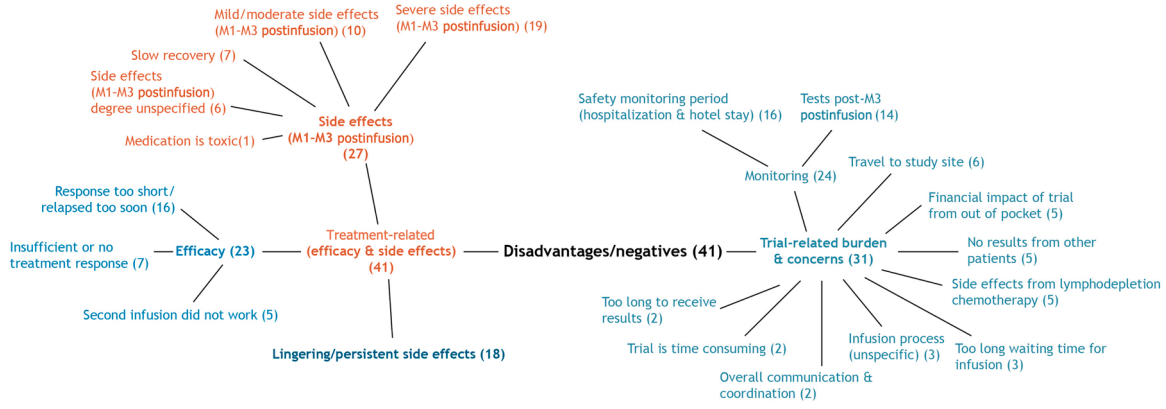

Fig. 2. Perceived disadvantages of ide-cel treatment through 24 months postinfusion. Numbers in parentheses are the number of patients who mentioned the concept in ≥ 1 of their interviews. M, month.

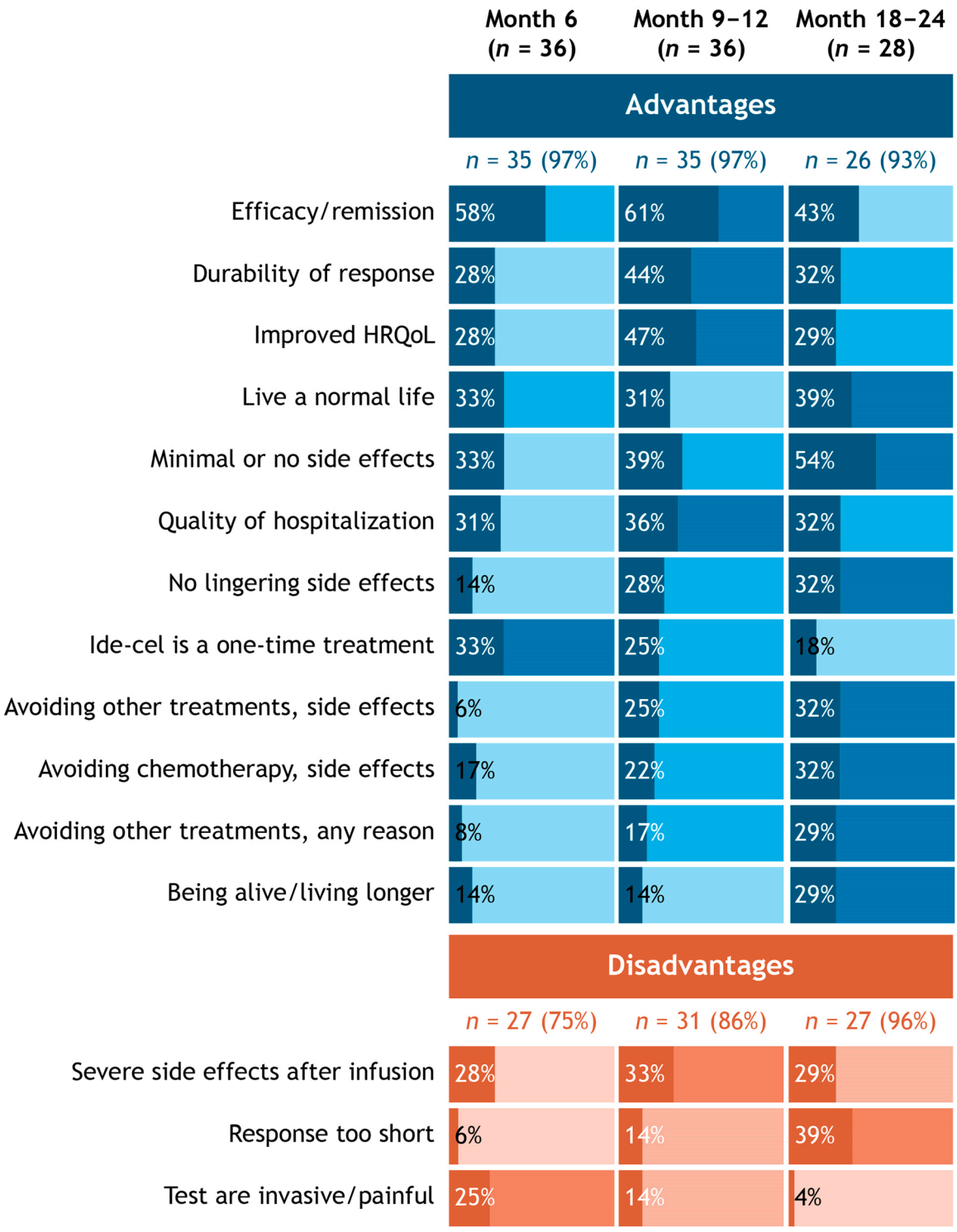

Fig. 3. Expressed importance of concepts over time. Included concepts in the figure were reported by ≥ 25% of interview responders. Numbers of patients represent patients who completed an interview at each time point. Bars represent the proportion of patients identifying the concept. Heatmap shading visually illustrates the proportionate values for each concept, where lighter shades are associated with lower proportions and darker shades represent higher proportions. HRQoL, health-related quality of life.

aspects highly (≥7/10), and explained their ratings as the result of severe side effects immediately postinfusion or a long recovery time, and 1 patient cited a short remission. Most (>80%) patients who were asked to weigh the benefits and negative aspects of ide-cel reported that the benefits outweighed the negatives at each time point (Appendix Figure A.2).

3.4.2. Perception of ide-cel relative to other treatments

When asked to consider ide-cel relative to other treatments, patients mostly reported that ide-cel was preferable regarding efficacy and side effects, and disadvantages of ide-cel were reported less frequently (mostly related to side effects postinfusion; Appendix Figure A.3).

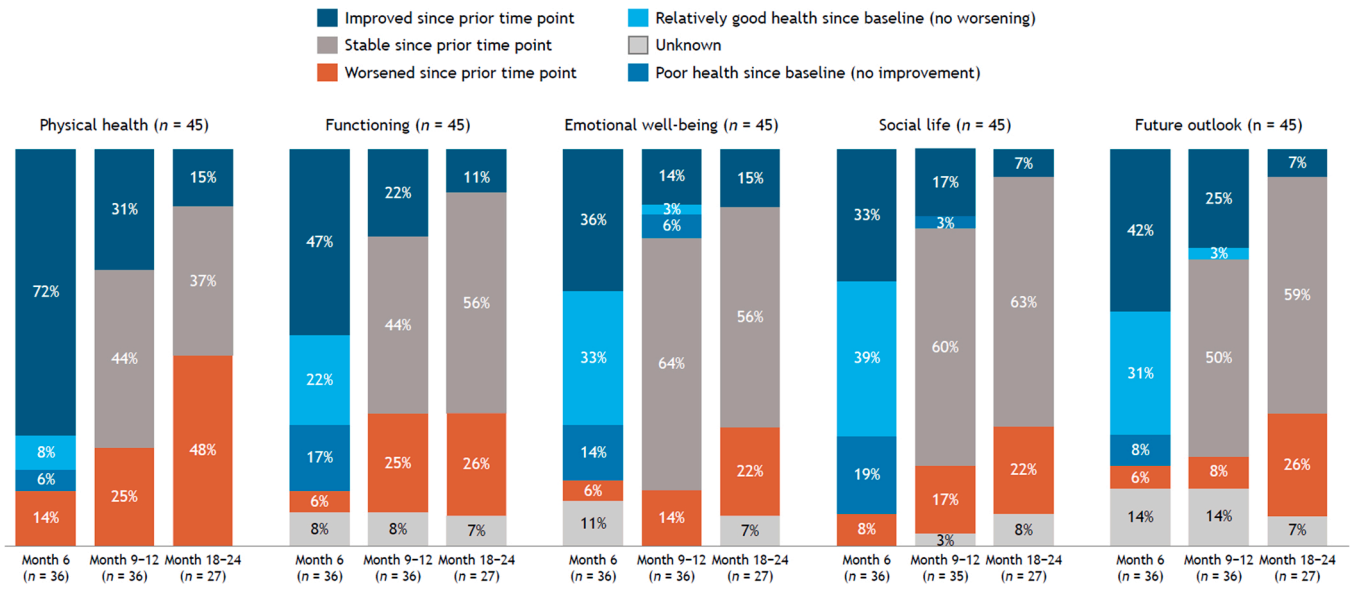

Fig. 4. Longitudinal changes in perceptions of well-being. Numbers above the bar charts for each area of well-being are the patients interviewed over the course of the whole trial, $n = 45$. Numbers below each individual bar represent patients who provided responses at each time point for that area of well-being.

3.4.3. Longitudinal perspectives on well-being

When asked about their general health and well-being at each interview from months 6–24, patients indicated 6-month improvements in physical health, functioning, emotional well-being, social life, and outlook on the future; these improvements remained "stable" through 18 and 24 months. By month 6, nearly three-quarters (72%, $n = 26/36$) of patients interviewed at that time point reported a positive change in their physical health. The distribution shifted toward stable physical health by months 9–12 and then declining physical health by months 18–24 (Fig. 4). Approximately half of the patients (47%, $n = 17/36$) reported improvement in functioning and daily activities, which shifted to a "stable" rating over time. Findings were similar for emotional well-being, social life, and future outlook (Fig. 4).

3.5. Patient journeys: individual-level analysis

Four patient journeys were identified from the narrative analysis, accounting for the experiences of 35/45 patients (78%). The patient journeys represented most common configurations of self-reported main treatment benefit and self-reported remission length. The distribution of patients according to these categories is provided in Table 2. Due to variability in patient experiences, configurations that included ≤ 3 patients are not described. Each of the 4 patient journeys are further summarized in the following sub-sections.

3.5.1. Patient journey #1: physical health and functioning benefit with < 2 years of remission (n = 15)

> *"[...] I can ride a bike. That's a commonplace example, but yesterday I rode my bike and my spirits have also lifted to such an extent that I feel I have so much vital energy I want to do lots of things."*

The most represented patient journey ($n = 15/45$, 33%) included patients with a physical health and functioning benefit and < 2 years of remission. Most of these patients ($n = 7/15$, 47%,) experienced a relapse 7–12 months postinfusion. This group most often reported increased energy and decreased fatigue that allowed them to socialize more and participate in more activities. For some, the benefit of returning to activities myeloma had taken away made the treatment worthwhile despite their eventual relapse.

Table 2
Determination of patient journeys[a] from the narrative analysis: Treatment benefit by patient-reported remission length from first ide-cel infusion.

	Self-reported remission length			
Benefit type	**≤ 1 year (*n* = 27)**	**> 1 year (*n* = 9)**	**≥ 2 years (*n* = 8)**	**Unclear (*n* = 1)**
Physical health/functioning (*n* = 17)	10	5	2	
Emotional/future outlook (*n* = 7)	5	2		
Physical and emotional benefits (*n* = 9)	3		6	
No benefit (*n* = 8)	7			1
Unclear (*n* = 4)	2	2		

[a] Each color represents patients on 1 of the 4 most common patient journeys, which altogether cover 78% ($n = 35$) of the patient sample.

3.5.2. Patient journey #2: emotional well-being and future outlook benefit with < 2 years of remission (n = 7)

> *"[…] I would love to have been one of those people who went out 2 or 3 years without relapsing but I think it took me about a year to relapse or close to it so that's about when a lot of people seem to relapse on it. I had a wonderful year!"*

The next patient journey grouped 7/45 (16%) patients together, 4 of whom experienced a relapse 7–12 months postinfusion. Other patients relapsed within 6 months ($n = 1$), 13–18 months ($n = 1$), and 19–23 months ($n = 1$) postinfusion. Although these patients had a variety of remission timing, they were analyzed as one group with a common theme of increased confidence to plan for the future and a positive emotional state despite worsening physical health and/or functioning. The emotional improvements were said to be meaningful despite other challenges.

3.5.3. Patient journey #3: multiple benefits with longest remission (n = 6)

> *"Just overall, I feel stronger. […] I feel almost normal, almost like I did before I was diagnosed with multiple myeloma."*

This patient journey included 6/45 (13%) patients who benefited the most of all, describing ide-cel treatment benefits across multiple domains with the longest remission time. These patients expressed a decrease in symptoms that had a positive effect on their physical functioning, with a common theme of being cautiously optimistic. Most expressed hope and happiness with some anxious feelings about a potential relapse, and improved emotional functioning and future outlook.

3.5.4. Patient journey #4: no benefit and shortest remission time (n = 7)

> *"[…] I have good days and bad days. There's a given amount of depression that goes, comes with it."*

The last journey included 7/45 (16%) patients who reported no benefit from the ide-cel infusion. Of the patients with no benefit, 3 showed worsening of symptoms and functioning, 5 relapsed within 6 months, 2 received a second ide-cel infusion with no success, and 4 went on to receive another treatment. Despite having experienced a relapse, 3 of the patients reported an acceptance of living with the disease.

3.6. Treatment decisions and informational needs

When asked to reflect on their decision to participate in the trial, most patients indicated they would repeat their decision to receive ide-cel: month 6 ($n = 33/36$, 92%), month 9 ($n = 28/32$, 88%), month 12 ($n = 18/23$, 78%), month 18 ($n = 18/21$, 86%), and month 24 ($n = 18/19$, 95%). One patient indicated they would not make the same decision again due to their short remission. Most indicated they would recommend ide-cel to a friend: month 6 ($n = 29/36$, 81%), month 9 ($n = 27/32$, 84%), month 12 ($n = 15/23$, 65%), month 18 ($n = 17/21$, 81%), and month 24 ($n = 16/19$, 84%).

4. Discussion

This study sought to characterize the experiences of patients 6–24 months after receiving ide-cel CAR T cell therapy in the KarMMa trial. This rich qualitative data offers a multidimensional view of the patient journey. Interviews revealed improving overall well-being through 1 year after ide-cel infusion that appeared to remain stable by 2 years postinfusion. Patients reported more advantages with ide-cel compared with other RRMM treatments, emphasizing a better side effect profile and avoidance of consecutive treatments, such that they would generally repeat their decisions to receive ide-cel and would recommend ide-cel to others. Perceived side effects immediately postinfusion were impactful, but overall patients believed that positive aspects of ide-cel outweighed the negative ones.

The longitudinal analysis of well-being showed improved physical health for most at 6 months postinfusion compared to baseline, stable physical health from month 6 to month 12, and then declining physical health for many patients who completed interviews at months 18 or 24, likely due to disease progression. Similar patterns were observed for physical functioning, emotional well-being, social life, and future outlook, which showed some improvement from baseline to month 6 that flattened to a "stable" rating for those completing interviews from month 12 onwards.

The patient narrative analysis identified 4 types of patients based on the kind of benefit they received and their known remission length. The biggest group described a benefit primarily in their physical health and functioning, another group primarily in their emotional well-being and/or future outlook, and another experienced both benefits equally. Although the length of patient-reported remission varied among those who experienced treatment benefits, many of those who reported physical and emotional benefits also remained in remission. Few patients reported no clear treatment benefit, most of whom relapsed within 1 year. Some patients could not be categorized due to insufficient data, but the narrative analysis facilitated a useful and accurate synthesis of the patient journey for most interviewed patients.

This report extends the findings of our initial analysis of pretreatment and up to 3 months of posttreatment patient experiences in the KarMMa trial [10]. These extensive patient experience and patient journey analyses up to 24 months for patients receiving ide-cel has been reported for the first time for a CAR T treatment, which could assist providers and patients in having a more informed consideration of ide-cel therapy for patients with TCE RRMM. These findings are complementary to those from validated HRQoL instruments that were also used in the KarMMa trial, where patients reported clinically meaningful improvements in various HRQoL measures, including pain and fatigue, sustained through 18 months after ide-cel infusion [9].

These findings should be interpreted in the context of certain strengths and limitations of qualitative research. The longitudinal design of this study offers a broader view of the TCE patient experience with CAR T cell therapy than has been available previously. The methodology of this interview study provided a wide variety of analytic approaches to explore multiple dimensions of the patient experience. All patients in the interview sample had chosen to participate in the interviews, thus, some sampling bias was likely and quantitative results should not be generalized to all patients. A notable attrition was also observed through the 24-month follow-up period, which is common in long-term qualitative studies based on voluntary patient interviews and not unexpected in relatively longer-term oncology studies.

5. Conclusions

Overall, patients in the pivotal phase 2 KarMMa clinical trial who completed interviews up to 2 years after receiving ide-cel infusion reported ide-cel to be preferable to other treatment options, citing more relative benefits than negative aspects, and would recommend ide-cel to others. Well-being continued to improve through 12 months and stabilized by 18–24 months. Side effects postinfusion did not deter patients from preferring ide-cel over other treatments and did not outweigh other benefits.

Author contributions

MD, PRO, NS, and NCM contributed to the conception/design of the study, data acquisition, and interpretation of data. OM, DSD, and JD contributed to the conception/design of the study, data acquisition, data analysis, and interpretation of data. JB contributed to the conception/design of the study, data analysis, and interpretation of data. MM contributed to data acquisition, data analysis, and interpretation of data. SL and HG contributed to data analysis and interpretation of data. TBC contributed to data acquisition and interpretation of data. All authors reviewed, edited, and provided critical input on manuscript drafts. All authors approved the final manuscript.

Funding

This study was funded by Celgene, a Bristol-Myers Squibb Company, in collaboration with 2seventy bio.

Declaration of Competing Interest

MD has received research funding and honoraria from Amgen, Celgene, Janssen, Karyopharm, and Sanofi. PRO has served as a consultant for and received honoraria from AbbVie, Amgen, Celgene, GlaxoSmithKline, Janssen, Kite Pharma, Oncopeptides, and Sanofi; has served as a consultant for Takeda; and has served on the board of directors or advisory committee and speakers bureau for Amgen, Bristol Myers Squibb, Celgene, GlaxoSmithKline, Janssen, Oncopeptides, Regeneron, and Sanofi. NS has worked in an advisory role for Allogene Therapeutics, Amgen, CareDx, CSL Behring, GlaxoSmithKline, Indapta Therapeutics, Karyopharm, Kite Pharma, Oncopeptides, and Sanofi; has received research funding from bluebird bio, Bristol Myers Squibb/Celgene, Janssen, Nektar, Poseida, Precision Biosciences, Sutro Biopharma, and Teneobio; and is an employee and stockholder of AstraZeneca. OM, SL, MM, and HG are employees of ICON plc. JD is an employee and stockholder of ICON plc. JB, DSD, and TBC are employees and stockholders of Bristol Myers Squibb. NCM has served as a consultant for AbbVie, Adaptive, Amgen, Bristol Myers Squibb, Janssen, Legend, Novartis, Pfizer, and Takeda; has served as a consultant for, holds stock, patents and royalties in, and is a member on a board of directors or advisory committee for Oncopeptides; and is an employee of Dana Farber Cancer Institute.

Data availability

BMS policy on data sharing may be found at https://www.bms.com/researchers-and-partners/independent-research/data-sharing-request-process.html.

Acknowledgements

We thank the patients and their caregivers, study investigators, and the clinical study teams who made this study possible. The authors received writing and editorial assistance in the preparation of this manuscript from Jeff Frimpter, MPH, of Excerpta Medica, funded by Bristol Myers Squibb. The authors are fully responsible for all content and editorial decisions for this manuscript.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.leukres.2023.107074.

References

[1] U.H. Gandhi, R.F. Cornell, A. Lakshman, Z.J. Gahvari, E. McGehee, M.H. Jagosky, et al., Outcomes of patients with multiple myeloma refractory to CD38-targeted monoclonal antibody therapy, Leukemia 33 (9) (2019) 2266–2275.
[2] S.K. Kumar, M.A. Dimopoulos, E. Kastritis, E. Terpos, H. Nahi, H. Goldschmidt, et al., Natural history of relapsed myeloma, refractory to immunomodulatory drugs and proteasome inhibitors: a multicenter IMWG study, Leukemia 31 (11) (2017) 2443–2448.
[3] J. Mikhael, Treatment options for triple-class refractory multiple myeloma, Clin. Lymphoma Myeloma Leuk. 20 (1) (2020) 1–7.
[4] I.S. Nijhof, N.W.C.J. van de Donk, S. Zweegman, H.M. Lokhorst, Current and new therapeutic strategies for relapsed and refractory multiple myeloma: an update, Drugs 78 (1) (2018) 19–37.
[5] N. Despiegel, C. Touboul, A. Flinois, G. Saba, F. Suzan, S. Gonzalez-McQuire, et al., Health-related quality of life of patients with multiple myeloma treated in routine clinical practice in France, Clin. Lymphoma Myeloma Leuk. 19 (1) (2019) e13–e28.
[6] M. Kamal, X.S. Wang, Q. Shi, T.M. Zyczynski, C. Davis, L.A. Williams, et al., Symptom burden and its functional impact in patients with "symptomatic" relapsed or refractory multiple myeloma, Support Care Cancer 29 (1) (2021) 467–475.
[7] N.C. Munshi, L.D. Anderson Jr., N. Shah, D. Madduri, J. Berdeja, S. Lonial, et al., Idecabtagene vicleucel in relapsed and refractory multiple myeloma, N. Engl. J. Med. 384 (8) (2021) 705–716.
[8] L.D. Anderson, N.C. Munshi, N. Shah, S. Jagannath, J.G. Berdeja, S. Lonial, et al., Idecabtagene vicleucel (ide-cel, bb2121), a BCMA-directed CAR T cell therapy, in relapsed and refractory multiple myeloma: updated KarMMa results, J. Clin. Oncol. 39 (2021) 8016.
[9] M. Delforge, N. Shah, J.S.F. Miguel, J. Braverman, D.S. Dhanda, L. Shi, et al., Health-related quality of life with idecabtagene vicleucel in relapsed and refractory multiple myeloma, Blood Adv. 6 (4) (2022) 1309–1318.
[10] N. Shah, M. Delforge, J. San-Miguel, O. Moshkovich, J. Braverman, D.S. Dhanda, et al., Patient experience before and after treatment with idecabtagene vicleucel (ide-cel, bb2121): qualitative analysis of patient interviews in the KarMMa trial, Leuk. Res. 120 (2022), 106921.
[11] S. Kumar, B. Paiva, K.C. Anderson, B. Durie, O. Landgren, P. Moreau, et al., International Myeloma Working Group consensus criteria for response and minimal residual disease assessment in multiple myeloma, Lancet Oncol. 17 (8) (2016) e328–e346.