Patient-reported quality of life in patients with relapsed/refractory cutaneous T-cell lymphoma: Results from the randomised phase III ALCANZA study

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Abstract: Background: Brentuximab vedotin was approved for adult patients with CD30-expressing cutaneous T-cell lymphoma treated with prior systemic therapy based on improved response rates and progression-free survival with brentuximab vedotin (1.8 mg/kg once every 3 weeks; 16 cycles) versus physician's choice (methotrexate/bexarotene; 48 weeks) in the phase III ALCANZA study. Quality of life (QoL) in ALCANZA patients was also examined. Methods: QoL measures in ALCANZA were based on the Skindex-29, Functional Assessment of Cancer Therapy-General (FACT-G) and European QoL 5-dimension (EQ-5D) questionnaires. Results: Mean maximum reduction from the baseline Skindex-29 symptom domain score (key secondary end-point) was greater with brentuximab vedotin than physician's choice (-27.96 versus -8.62); the difference, -18.9 (95% confidence interval -26.6, -11.2; adjusted $p < 0.001$), exceeded the study-defined minimally important difference (9.0-12.3). Mean changes from baseline to end-of-treatment visit total FACT-G scores were similar with brentuximab vedotin and physician's choice (0.15 versus -2.29). EQ-5D changes were also comparable between arms. Among brentuximab vedotin-treated patients with peripheral neuropathy (PN), mean maximum reduction in Skindex-29 symptom domain was -35.54 versus -11.11 in patients without PN. PN had no meaningful effect on FACT-G and EQ-5D QoL scores. Conclusions: In summary, brentuximab vedotin produced superior reductions in symptom burden compared with physician's choice, without adversely impacting QoL. QoL was unaffected by the presence of PN in brentuximab vedotin-treated patients. Clinical trial registration: NCT01578499.

DOI: https://doi.org/10.1016/j.ejca.2020.04.010

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DOI: https://doi.org/10.1016/j.ejca.2020.04.010

European Journal of Cancer 133 (2020) 120–130

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.ejcancer.com

Original Research

Patient-reported quality of life in patients with relapsed/refractory cutaneous T-cell lymphoma: Results from the randomised phase III ALCANZA study

Reinhard Dummer [a,*], Henry M. Prince [b], Sean Whittaker [c], Steven M. Horwitz [d], Youn H. Kim [e], Julia Scarisbrick [f], Pietro Quaglino [g], Pier Luigi Zinzani [h], Pascal Wolter [i], Herbert Eradat [j], Lauren Pinter-Brown [k], Jose A. Sanches [l], Pablo L. Ortiz-Romero [m], Oleg E. Akilov [n], Larisa Geskin [o], Auris Huen [p], Jan Walewski [q], Yinghui Wang [r], Julie Lisano [r], Akshara Richhariya [r], Joseph Feliciano [r], Yanyan Zhu [s], Veronica Bunn [s], Meredith Little [s], Erin Zagadailov [s], Mehul R. Dalal [s], Madeleine Duvic [p]

[a] *Universitäts Spital Zürich, Rämistrasse 100, Zürich 8091, Switzerland*
[b] *Peter MacCallum Cancer Centre, Locked Bag 1, A'Beckett Street, Melbourne, Victoria 8066, Australia*
[c] *Division of Genetics and Molecular Medicine, Faculty of Life Sciences and Medicine, Kings College London & Guys and St Thomas NHS Foundation Trust, London, UK*
[d] *Memorial Hospital, 1275 York Avenue, Between 67th and 68th Streets, New York, NY 10065, USA*
[e] *Stanford Clinical Cancer Center, 875 Blake Wilbur Drive, Stanford, CA 94305, USA*
[f] *Nuffield House, Dermatology – University Hospitals Birmingham NHS Foundation Trust, Queen Elizabeth Hospital, Queen Elizabeth Medical Centre, Birmingham B15 2TH, UK*
[g] *University of Turin, Turin, Italy*
[h] *Institute of Hematology "Seràgnoli", University of Bologna, Via Massarenti 9, Bologna 40138, Italy*
[i] *University Hospitals Leuven, Leuven, Belgium*
[j] *Hematology Oncology, UCLA Lymphoma Program, Bone Marrow Transplant Program, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA*
[k] *Chao Family Comprehensive Cancer Center, University of California, Irvine, CA, USA*
[l] *Division of Clinical Dermatology, Hospital Das Clinicas, FMUSP, Department of Dermatology, University of Sao Paulo Medical School, Brazil*
[m] *University Hospital 12 de Octubre, Institute i+12, Medical School, Universidad Complutense, Madrid, Spain*

* *Corresponding author*. University Hospital Zürich and University of Zürich, Gloriastrasse 31, Zürich 8091, Switzerland. Fax: +41 44 255 89 88.
E-mail address: reinhard.dummer@usz.ch (R. Dummer), miles.prince@petermac.org (H.M. Prince), sean.whittaker@gstt.nhs.uk (S. Whittaker), horwitzs@MSKCC.ORG (S.M. Horwitz), younkim@stanford.edu (Y.H. Kim), Julia.Scarisbrick@uhb.nhs.uk (J. Scarisbrick), Pietro.quaglino@unito.it (P. Quaglino), pierluigi.zinzani@unibo.it (P.L. Zinzani), pascalwolter@hotmail.com (P. Wolter), Heradat@mednet.ucla.edu (H. Eradat), lpinterb@uci.edu (L. Pinter-Brown), jasanchesjr@gmail.com (J.A. Sanches), portiz.hdoc@salud.madrid.org (P.L. Ortiz-Romero), akilovoe@upmc.edu (O.E. Akilov), ljg2145@cumc.columbia.edu (L. Geskin), aohuen@mdanderson.org (A. Huen), jan.walewski@coi.pl (J. Walewski), ywang@seagen.com (Y. Wang), jlisano@seagen.com (J. Lisano), arichhariya@seagen.com (A. Richhariya), felicianojoseph1@gmail.com (J. Feliciano), Yanyan.Zhu@takeda.com (Y. Zhu), Veronica.Bunn@takeda.com (V. Bunn), meredith.little@takeda.com (M. Little), erin.zagadailov@gmail.com (E. Zagadailov), mehul.dalal@takeda.com (M.R. Dalal), mduvic@mdanderson.org (M. Duvic).

https://doi.org/10.1016/j.ejca.2020.04.010

[n] University of Pittsburgh School of Medicine, Biomedical Science Tower, Room E1157, 200 Lothrop Street, Pittsburgh, PA 15261-2109, USA
[o] Department of Dermatology, Columbia University and CUMC, 161 Fort Washington Ave, 12th Floor, New York, NY 10032, USA
[p] University of Texas MD Anderson Cancer Center, 1515 Holcombe Blvd, Box 1452, Houston, TX, USA
[q] Maria Sklodowska-Curie National Research Institute of Oncology, 5 WK Roentgen Str, Warszawa 02-781, Poland
[r] Seattle Genetics, Inc., Bothell, WA, USA
[s] Millennium Pharmaceuticals Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Cambridge, MA, USA

Received 6 April 2020; accepted 7 April 2020
Available online 2 June 2020

KEYWORDS
Brentuximab vedotin;
Quality of life;
Cutaneous T-cell lymphoma;
CD30;
Clinical trial;
Phase III

Abstract ***Background:*** Brentuximab vedotin was approved for adult patients with CD30-expressing cutaneous T-cell lymphoma treated with prior systemic therapy based on improved response rates and progression-free survival with brentuximab vedotin (1.8 mg/kg once every 3 weeks; ≤16 cycles) versus physician's choice (methotrexate/bexarotene; ≤48 weeks) in the phase III ALCANZA study. Quality of life (QoL) in ALCANZA patients was also examined.

Methods: QoL measures in ALCANZA were based on the Skindex-29, Functional Assessment of Cancer Therapy-General (FACT-G) and European QoL 5-dimension (EQ-5D) questionnaires.

Results: Mean maximum reduction from the baseline Skindex-29 symptom domain score (key secondary end-point) was greater with brentuximab vedotin than physician's choice (−27.96 versus −8.62); the difference, −18.9 (95% confidence interval −26.6, −11.2; adjusted $p < 0.001$), exceeded the study-defined minimally important difference (9.0−12.3). Mean changes from baseline to end-of-treatment visit total FACT-G scores were similar with brentuximab vedotin and physician's choice (0.15 versus −2.29). EQ-5D changes were also comparable between arms. Among brentuximab vedotin-treated patients with peripheral neuropathy (PN), mean maximum reduction in Skindex-29 symptom domain was −35.54 versus −11.11 in patients without PN. PN had no meaningful effect on FACT-G and EQ-5D QoL scores.

Conclusions: In summary, brentuximab vedotin produced superior reductions in symptom burden compared with physician's choice, without adversely impacting QoL. QoL was unaffected by the presence of PN in brentuximab vedotin-treated patients.

Clinical trial registration: NCT01578499.

1. Introduction

Cutaneous T-cell lymphomas (CTCLs) are a heterogeneous group of non-Hodgkin lymphomas characterised by clonal T-cell skin infiltrations [1,2]. Common CTCL variants include mycosis fungoides (MF; representing >50% of all CTCL cases), primary cutaneous anaplastic large-cell lymphoma (pcALCL) and Sézary's syndrome [3,4]. Because of the chronic recurrent nature of CTCL, complete responses (CRs) to treatment are rare, and patients frequently experience skin relapses or become treatment-refractory [5–7]. In addition, CTCL is often visibly disfiguring, causing pruritus and pain [8], with a symptom burden that can be highly detrimental to patients' well-being [9], making quality of life (QoL) maintenance a key patient-management goal [10].

Brentuximab vedotin, a CD30-targeting antibody–drug conjugate, is approved in Europe and the United States of America (USA) for treatment of CTCL patients, including pcALCL and CD30-expressing MF, who have received prior systemic therapy [11,12]. Approval was granted based on the phase III ALCANZA trial results (NCT01578499), demonstrating significantly improved objective response with brentuximab vedotin versus physician's choice (PC; methotrexate or bexarotene) in patients with previously treated CD30-expressing MF or pcALCL (56.3% versus 12.5%; $p < 0.0001$) [13], and an acceptable safety profile that was consistent with that in other malignancies.

Peripheral neuropathy (PN), one of the commonest toxicities associated with brentuximab vedotin, occurred in 67% of patients, versus 6% with PC.

To reflect the importance of QoL in CTCL, ALCANZA also evaluated patient-reported outcome (PRO) measures; results are reported here.

2. Methods

2.1. Study design and patient population

Study design and patient population have been described previously [13]. QoL questionnaires were administered before the first dose, on all even-numbered cycles thereafter, at the end-of-treatment and during post-treatment follow-up. The trial was conducted in accordance with the International Conference on Harmonization guidelines for Good Clinical Practice, and appropriate regulatory requirements. Local ethics committees/institutional review boards approved the protocol, and patient safety was monitored via an Independent Data Monitoring Committee.

2.2. PRO

Skindex-29 is a 29-item dermatology-specific questionnaire [14] used extensively in CTCL patients [9,15]. The total Skindex-29 score is the sum of three domain (symptoms, emotions and functioning) scores (high scores indicate poorer QoL) [16].

Functional Assessment of Cancer Therapy-General (FACT-G; version 4), a 27-item cancer-specific PRO measure, comprises four subscales (physical, social/family, emotional and functional well-being) combined to obtain a total score (high score indicates better QoL) [17].

European QoL 5-dimension (EQ-5D), a five-item questionnaire, comprises a descriptive system and visual analogue scale (VAS) [18,19]. The three-level version recorded patients' perceptions of the impact of 'disability' (severe, moderate or none) on mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The VAS recorded self-rated health on a 0–100 scale (worst- to best-imaginable health state). EQ-5D time trade-off indexed data were analysed using both United Kingdom (UK)- and USA-based value sets.

2.3. Minimal important differences

Minimal important difference (MID) is defined as the smallest change in score that is regarded as significant from a patient's or clinician's perspective to trigger changes in disease treatment or management. At the time of data cut-off, there was no validated Skindex-29-specific MID for CTCL. Therefore, Skindex-29 symptom domain MIDs were estimated using three different distribution-based methods: half of a standard deviation (SD) approach, Cohen's moderate effect size and standard error of measurement (Supplementary Material, Methods) [20,21]. MIDs for the Skindex-29 symptom domain were estimated as 12.282, 11.238 and 9.045, respectively. FACT-G MID is reported as 2–3 points for physical and functional subscales, 2 points for the emotional subscale and 5–7 points for FACT-G total score [17]. The mean MID for EQ-5D time trade-off indexed data for both UK- and USA-based value sets was 0.074 (range −0.011 to 0.139) [18].

2.4. QoL objectives and assessment

Mean maximum reduction from baseline in Skindex-29 symptom domain was a key secondary end-point; other QoL secondary end-points included changes from baseline in Skindex-29 total, emotions and functioning domain scores, and FACT-G total and subscale scores. EQ-5D outcomes were an exploratory end-point.

2.5. Statistical analysis

p-Values were calculated using analysis of covariance, controlling for baseline symptom domain score, performance status score (0 and ≥1) and disease diagnosis (pcALCL and MF). *p*-Values adjusted for testing multiple key secondary end-points based on the weighted Holm's procedure were also provided.

Time to, and duration of, Skindex-29 symptom domain improvement were assessed using the three MIDs determined for symptom domain score. Time to Skindex-29 improvement was defined as the time from randomisation to the first reduction in symptom score of ≥MID, with patients censored at the date of their last Skindex-29 assessment before, or at end of treatment (EOT). Duration of Skindex-29 improvement was defined as the time from the first reduction in symptom score of ≥MID, before, or at EOT, to the date at which the reduction from baseline reverted to <MID. Time to, and duration of, Skindex-29 improvement were summarised descriptively using Kaplan–Meier methodology.

Changes from baseline Skindex-29 total score and emotions/functioning domain scores, and changes from baseline FACT-G (total score and subscales) and EQ-5D scores over time were analysed to determine if response to, and side-effects of, therapy (specifically PN), were accompanied by measurable changes in PROs. QoL questionnaire scores were summarised with descriptive statistics.

3. Results

The population included 128 CD30-expressing CTCL patients randomised to receive brentuximab vedotin ($n = 64$) or PC ($n = 64$) [13]. Baseline characteristics

and QoL scores were similar across study arms (Table 1). QoL questionnaire compliance was high in both arms (82.5–100% for brentuximab vedotin patients and 70.0–100% for PC patients) and was sustained throughout the study (Supplementary Table 1).

3.1. Skindex-29 symptom domain score

Mean Skindex-29 symptom domain scores over time are shown in Fig. 1. The mean maximum reduction from baseline scores was significantly greater with brentuximab vedotin versus PC (−27.96 [SD 26.877] versus −8.62 [SD 17.013]; $p < 0.001$; adjusted $p < 0.001$). The estimated difference between brentuximab vedotin and PC arms of −18.9 (95% confidence interval [CI] −26.6, −11.2) exceeded estimated MIDs of 9.0, 11.2 and 12.3.

In the brentuximab vedotin arm, 63% (40/64) of patients achieved a reduction from baseline >MID of 12.3, versus 39% (25/64) of PC-treated patients. Using this MID, the median time to Skindex-29 symptom burden improvement was 2.1 versus 5.0 months, and the median duration of symptom burden improvement was 10.6 versus 3.5 months (Table 2) in brentuximab vedotin and PC arms, respectively. About 66% (42/64) and 44% (28/64) of patients achieved a reduction from baseline of >MID of 9.0 in brentuximab vedotin and PC arms, respectively. Using this MID, respective median times to Skindex-29 improvement were 2.1 versus 3.9 months, and median durations of improvement were not estimable versus 4.2 months in brentuximab vedotin and PC arms, respectively.

In a *post-hoc* analysis, most brentuximab vedotin-treated patients had reduced symptom burden regardless of response to treatment (Fig. 2).

Table 1
Patient baseline characteristics.

Characteristics	Brentuximab vedotin ($n = 64$)	Methotrexate or bexarotene ($n = 64$)
Median age, years (range)	62 (22–83)	59 (22–83)
Male gender, *n* (%)	33 (52)	37 (58)
ECOG PS 0–1, *n* (%)	61 (95)	62 (97)
MF,[a] *n* (%)	48 (75)	49 (77)
Early stage (IA–IIA)	15 (31)	18 (37)
Advanced stage (IIB–IVB[b])	32 (67)	30 (61)
pcALCL, *n* (%)	16 (25)	15 (23)
Skin only	9 (56)	11 (73)
Extracutaneous disease	7 (44)	4 (27)
Total number of prior therapies, median (range)	4.0 (0–13)	3.5 (1–15)
Number of prior systemic therapies, median (range)	2.0 (0–11)	2.0 (1–8)
Mean baseline scores (SD)		
Skindex-29 total	49.8 (22.0)	47.9 (20.0)
Skindex-29 symptoms domain	57.5 (23.4)	55.1 (21.1)
Skindex-29 emotions domain	49.5 (22.4)	45.8 (22.9)
Skindex-29 functioning domain	42.3 (25.9)	40.4 (25.0)
FACT-G total	71.2 (17.0)	73.1 (17.9)
FACT-G physical well-being	19.8 (6.3)	20.0 (6.3)
FACT-G social/family well-being	20.3 (6.2)	22.0 (6.0)
FACT-G emotional well-being	15.4 (4.5)	15.4 (5.3)
FACT-G functional well-being	15.6 (6.1)	15.9 (7.1)
EQ-5D VAS	60.6 (20.3)	61.7 (23.6)
EQ-5D UK time trade-off	0.68 (0.29)	0.63 (0.32)
EQ-5D USA time trade-off	0.78 (0.13)	0.75 (0.24)

ECOG PS, Eastern Cooperative Oncology Group performance status; MF, mycosis fungoides; pcALCL, primary cutaneous anaplastic large-cell lymphoma; SD, standard deviation; FACT-G, Functional Assessment of Cancer Therapy-General; EQ-5D, European quality of life 5-dimension; VAS, visual analogue scale.

[a] One patient in each arm had incomplete staging data and are not included.

[b] Stage IVB MF, $n = 7$ in brentuximab arm versus $n = 0$ in methotrexate/bexarotene arm.

3.2. Skindex-29 total and other domain scores

Mean changes from baseline to EOT Skindex-29 composite total score were greater with brentuximab vedotin (−14.84 [SD 22.681]) than with PC (−0.96 [SD 18.973]) (Fig. 1). For Skindex-29 emotions and functioning domain scores, there were no significant treatment differences over time (Fig. 1); however, brentuximab vedotin-treated patients had lower scores (indicating lower impact of skin disease) at EOT for both domains. Mean changes in emotions domain from baseline to EOT were −14.43 (SD 20.901) with brentuximab vedotin and −1.84 (SD 18.555) with PC. Changes in mean functioning domain from baseline to EOT were −11.10 (SD 25.312) with brentuximab vedotin and −1.22 (SD 22.448) with PC. Median changes from baseline to EOT with brentuximab vedotin and PC, respectively, were −12.50 (range −72.5 to 35.0) and −2.50 (range −40.0 to 40.0) for the emotions domain, and −6.34 (range −75.0 to 32.2) and −2.08 (range −56.3 to 58.3) for the functioning domain.

3.3. FACT-G scores

FACT-G questionnaire results showed no significant treatment differences. Mean FACT-G total score changes from baseline to EOT were 0.15 (SD 16.388) with brentuximab vedotin and −2.29 (SD 17.171) with PC (Fig. 3); neither were >MID of 5–7 points [17]. However, brentuximab vedotin-treated patients had higher overall scores (better QoL) from cycles 2 to 12, and at EOT, versus PC-treated patients. Neither treatment group experienced meaningful differences in FACT-G scores for emotional, social/family, physical and functional subscales over time (Supplementary Fig. 1).

3.4. EQ-5D scores

In both arms, no substantial changes from baseline EQ-5D score were observed over time (data not shown), although trends for overall higher scores were observed in the brentuximab vedotin arm. Mean changes from baseline to EOT in EQ-5D USA and UK time trade-offs were 0.02 and 0.03, respectively, in the brentuximab

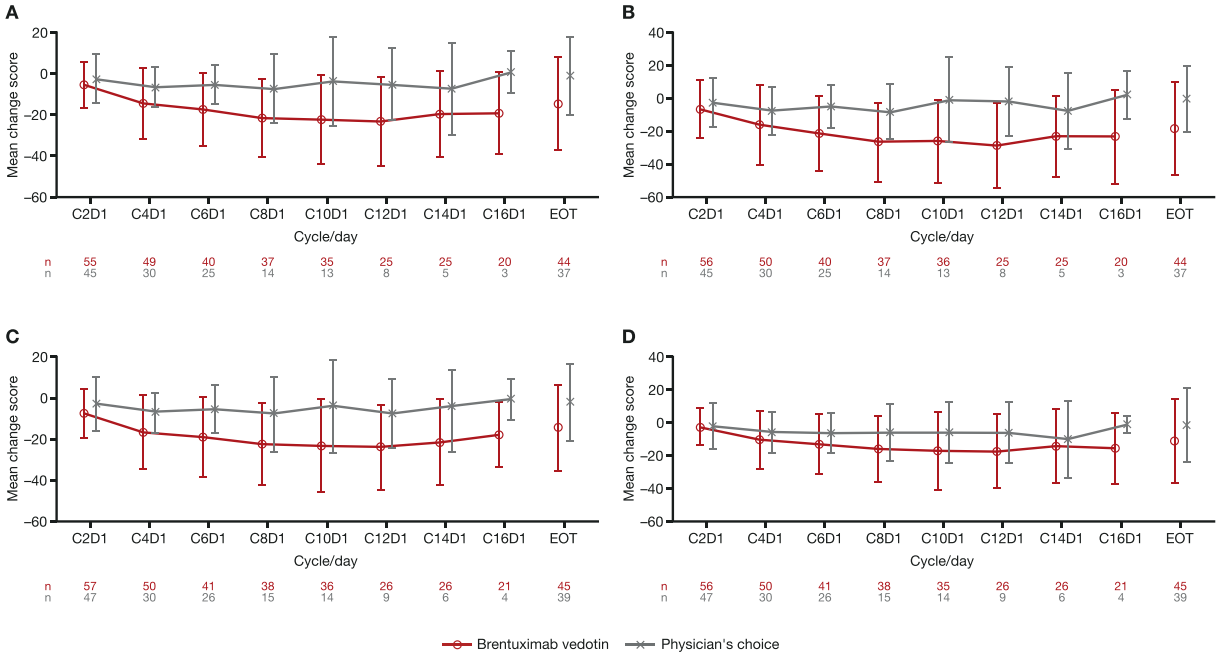

Fig. 1. Mean change from baseline in Skindex-29 total and domain scores in evaluable patients, including the key secondary end-point of Skindex-29 symptom domain score: (A) total score, (B) symptom domain, (C) emotions domain and (D) functioning domain. Bar represents mean ± standard deviation. Higher scores indicate a higher impact of skin disease on quality of life. The psychometric validity of a sum score has not been established. The developer recommends calculating and reporting it largely to simplify the presentation of results. C, cycle; D, day; EOT, end of treatment.

vedotin arm, and −0.02 and −0.04, respectively, in the PC arm. These results were not >MID for UK- and USA-indexed data of 0.074 (range −0.011 to 0.140).

3.5. Impact of PN on QoL in the brentuximab vedotin arm

Changes in QoL scores were also evaluated in brentuximab vedotin-treated patients according to occurrence/absence of treatment-emergent PN, and by PN grade (maximum grade 1 versus maximum grade 2/3). PN events were reported for 44 of 66 patients (67%) in the brentuximab vedotin arm [13], which were grade 1 (n = 17), grade 2 (n = 21) and grade 3 (n = 6). Changes in Skindex-29 total score, FACT-G total score and EQ-5D VAS score over time in the brentuximab vedotin arm are shown by maximum grade of PN experienced (Fig. 4) and by PN presence or absence (Supplementary Fig. 2). Mean maximum reduction in Skindex-29 symptom domain scores in patients with any PN were −35.54 (SD 23.991) versus −11.11 (SD 25.809) in patients without neuropathy (data not shown). Mean maximum reductions were similar in patients with grade 2/3 PN versus grade 1 PN (−36.72 versus −33.33). No clinically meaningful differences in FACT-G total or EQ-5D VAS scores were seen between patients with or without PN (Supplementary Fig. 2).

4. Discussion

CTCL patients frequently report ongoing cutaneous symptoms, including rash, severe pruritus and hair loss, which can impact their QoL considerably (affecting social, emotional and functional aspects) and ability to undertake normal daily activities [8,22–24]. A 2005 survey of the US National Cutaneous Lymphoma Foundation reported that 41% of patients felt that CTCL had impacted work or school attendance, and 53% had experienced some degree of depression as a result of their disease [9]. Consequently, the ongoing evaluation of PROs for symptom burden and QoL is essential to ascertain if a treatment can improve and maintain patient well-being, and such measures should be routinely assessed in clinical trials for CTCL [25,26]. For relapsed/refractory CTCL patients, it is important that new therapeutics both improve clinical responses and reduce skin symptom burden without adversely impacting QoL.

ALCANZA demonstrated superior clinical efficacy with brentuximab vedotin versus PC in terms of response and progression-free survival [13]. To reflect the importance of QoL in CTCL, ALCANZA evaluated QoL PROs. The current analysis demonstrated that the key secondary end-point, Skindex-29 symptom burden, was significantly reduced with brentuximab vedotin versus PC. Despite the open-label study design, QoL questionnaire compliance was high (>70% in both arms), supporting the validity of these results.

Using Skindex-29, we observed a greater reduction from baseline symptom burden with brentuximab vedotin compared with PC. Treatment differences exceeded all three estimated MIDs, demonstrating a

Table 2
Summary of time to improvement and duration of improvement in Skindex-29 symptom domain score, according to three different study-determined minimum important differences.

MID	End-point	Brentuximab vedotin	Methotrexate or bexarotene	Bexarotene	Methotrexate	Total	HR (95% CI)[a]	*p*-Value[b]
12.282	**Time to improvement**							
	Number with events, *n*/*N* (%)	40/64 (63)	25/64 (39)	20/38 (53)	5/26 (19)	65/128 (51)	1.62 (0.98, 2.68)	0.052
	Number censored, %	24 (38)	39 (61)	18 (47)	21 (81)	63 (49)		
	Median (95% CI), months	2.1 (2.1, 3.5)	5.0 (2.2, NE)	3.6 (2.1, 8.6)	NE (2.1, NE)	2.8 (2.1, 4.2)		
	Duration of improvement							
	Number with events, *n*/*N* (%)	16/40 (40)	11/25 (44)	10/20 (50)	1/5 (20)	27/65 (42)		
	Number censored, %	24 (60)	14 (56)	10 (50)	4 (80)	38 (58)		
	Median (95% CI), months	10.6 (4.9, NE)	3.5 (1.4, 6.9)	3.5 (1.4, 6.9)	NE (2.8, NE)	8.2 (3.5, NE)		
11.238	**Time to improvement**							
	Number with events, *n*/*N* (%)	40/64 (63)	25/64 (39)	20/38 (53)	5/26 (19)	65/128 (51)	1.64 (0.99, 2.72)	0.046
	Number censored, %	24 (38)	39 (61)	18 (47)	21 (81)	63 (49)		
	Median (95% CI), months	2.1 (2.1, 3.5)	5.0 (2.2, NE)	3.6 (2.1, 8.6)	NE (2.1, NE)	2.8 (2.1, 4.2)		
	Duration of improvement							
	Number with events, *n*/*N* (%)	16/40 (40)	11/25 (44)	10/20 (50)	1/5 (20)	27/65 (42)		
	Number censored, %	24 (60)	14 (56)	10 (50)	4 (80)	38 (58)		
	Median (95% CI), months	10.6 (4.9, NE)	3.5 (1.4, 6.9)	3.5 (1.4, 6.9)	NE (2.8, NE)	8.2 (3.5, NE)		
9.045	**Time to improvement**							
	Number with events, *n*/*N* (%)	42/64 (66)	28/64 (44)	21/38 (55)	7/26 (27)	70/128 (55)	1.59 (0.98, 2.57)	0.053
	Number censored, %	22 (34)	36 (56)	17 (45)	19 (73)	58 (45)		
	Median (95% CI), months	2.1 (1.1, 2.8)	3.9 (2.2, 8.6)	3.6 (2.1, 6.3)	5.0 (2.0, NE)	2.5 (2.1, 3.6)		
	Duration of improvement							
	Number with events, *n*/*N* (%)	13/42 (31)	11/28 (39)	8/21 (38)	3/7 (43)	24/70 (34)		
	Number censored, %	29 (69)	17 (61)	13 (62)	4 (57)	46 (66)		
	Median (95% CI), months	NE (10.6, NE)	4.2 (1.5, 6.9)	4.2 (1.4, NE)	2.8 (1.3, NE)	10.6 (6.3, NE)		

MID, minimal important difference; HR, hazard ratio; CI, confidence interval; NE, not estimable; MF, mycosis fungoides; pcALCL, primary cutaneous anaplastic large-cell lymphoma.
Duration of Skindex-29 improvement is based on the subset of patients with Skindex-29 improvement.
[a] HR for brentuximab vedotin versus physician's choice (methotrexate or bexarotene) with the 95% CI from a stratified Cox regression model, with treatment as the explanatory variable and baseline disease diagnosis (MF or pcALCL) as a stratification factor. A hazard ratio >1 indicates better time to response in the brentuximab vedotin arm.
[b] *p*-Value is calculated using log-rank test stratified by baseline disease diagnosis (MF or pcALCL).

clinically meaningful improvement. These effects were sustained regardless of response status (*post-hoc*). A high proportion of patients individually achieved a clinically meaningful reduction in Skindex-29 symptom domain score with brentuximab vedotin, including some patients who did not achieve objective responses. During treatment, improvements were rapid (median time to improvement: 2.1 months) and durable (median duration >10 months) compared with patients receiving PC (3.9 and 3.5 months, respectively), highlighting the rapid and sustained benefits seen with brentuximab vedotin. There were no apparent treatment differences in Skindex-29 emotional and functioning domains over time; however, trends suggested a greater reduction in the impact of skin disease on QoL with brentuximab vedotin. No significant or clinically meaningful treatment differences were seen for the other PROs. Therefore, treatment with brentuximab vedotin improved cutaneous symptom burden (skin itching, burning, pain, irritation and bleeding) while maintaining other more general QoL aspects (e.g. emotions, functioning, social/family, physical and overall health status) at a similar level to that achieved with previous standard-of-care treatment.

The evaluation of change from baseline in the context of MIDs for each PRO was used to aid interpretation of results; however, at the time of the ALCANZA study, there was no validated Skindex-29-specific MID for CTCL. Consequently, the study sponsor used distribution-based methods to calculate an appropriate MID range for the Skindex-29 data. An approach consistent with the European Medicines Agency guidance regarding the use of patient-reported outcomes in oncology studies [27]. Use of multiple independent distribution-based methods to generate a range of values produces a robust analysis [28]. However, each approach invariably results in different MID definitions, which will not define a single specific MID threshold, and these methods provide no information on the clinical relevance of the change [29]. Nevertheless, the difference in maximum mean reduction from baseline Skindex-29 symptom domain scores between brentuximab vedotin and PC arms exceeded all three study-derived MIDs.

PN, a known side-effect of brentuximab vedotin (median time to onset: ~3 months) can often be dose-limiting [12,30,31]. Between 2010 and 2016, brentuximab vedotin-treated lymphoma patients reported that brentuximab vedotin-related PN affected

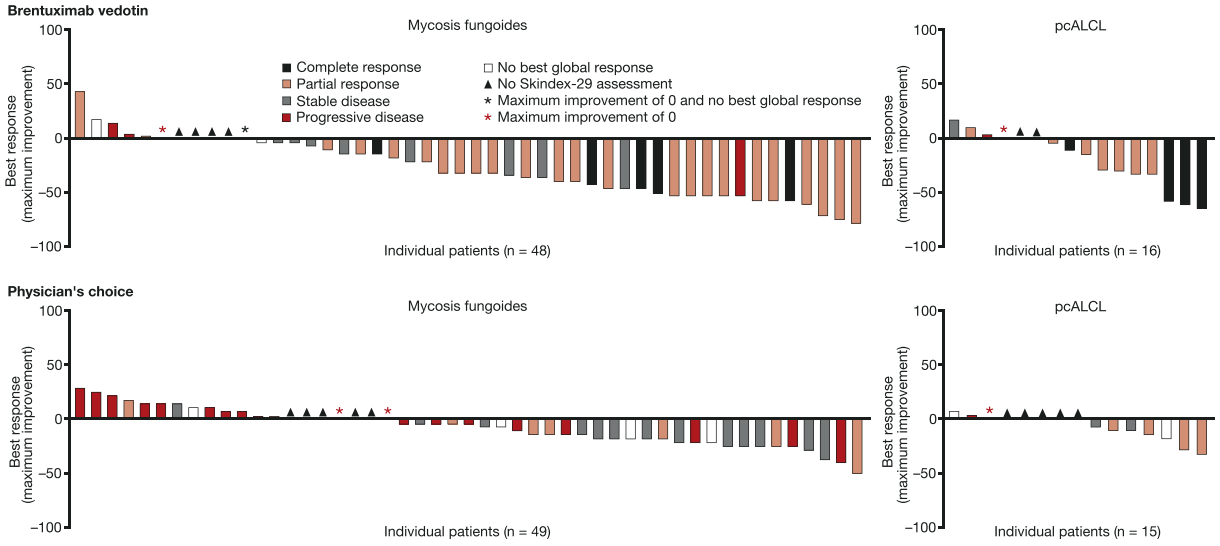

Fig. 2. Waterfall plot of maximum percent change from baseline in Skindex-29 symptom domain score by response in patients with mycosis fungoides and primary cutaneous anaplastic large-cell lymphoma (*post-hoc* analysis; intent-to-treat population). pcALCL, primary cutaneous anaplastic large-cell lymphoma.

their QoL (50%) and work (20%) [30]. The consensus among these patients was that brentuximab vedotin's benefits largely outweighed the risks [30]. However, 54% had Hodgkin lymphoma differentiating them from the ALCANZA population. Therefore, the importance of QoL and the magnitude of changes from baseline may differ for ALCANZA CTCL patients. In this analysis, QoL was neither affected adversely by brentuximab vedotin-related PN, nor did PN severity appear to affect skin symptom burden reductions.

As the ALCANZA study was open-label, QoL scores may have been subject to bias because patients were aware that they were receiving brentuximab vedotin and may therefore have overestimated treatment benefit; however, the magnitude of this potential bias is difficult to quantify [32,33]. Furthermore, the number of patients with responses declined during treatment because of discontinuations in both arms, and no multiple imputation methodology was used to account for missing data over time; nevertheless, the trends observed during treatment were also observed at the EOT visit. As the study only looked at two specific variants of CTCL (MF and pcALCL), the QoL results should not be extrapolated across other CTCL disease subtypes, such as Sézary's syndrome. Finally, as none of the QoL questionnaires were disease-specific, it is unclear whether QoL changes related explicitly to CTCL have been captured. Despite these limitations, this analysis provides valuable information with an important patient perspective.

In conclusion, ALCANZA data indicate that brentuximab vedotin may improve the skin symptom burden of patients with previously treated CD30-expressing CTCL requiring systemic therapy compared with PC, as evidenced by superior reductions

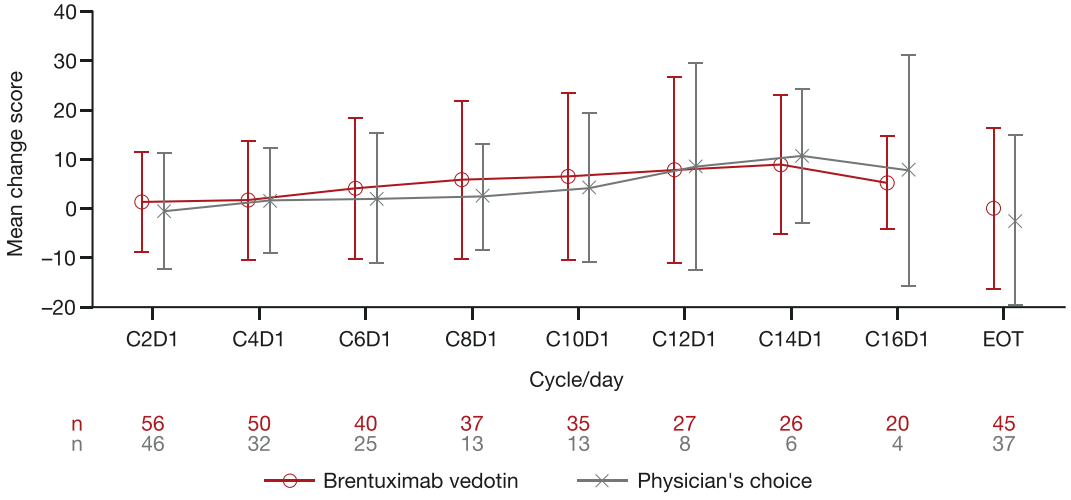

Fig. 3. Mean change from baseline in Functional Assessment of Cancer Therapy-General total score in evaluable patients. Bar represents mean ± standard deviation. Higher scores indicate a better quality of life. C, cycle; D, day; EOT, end of treatment.

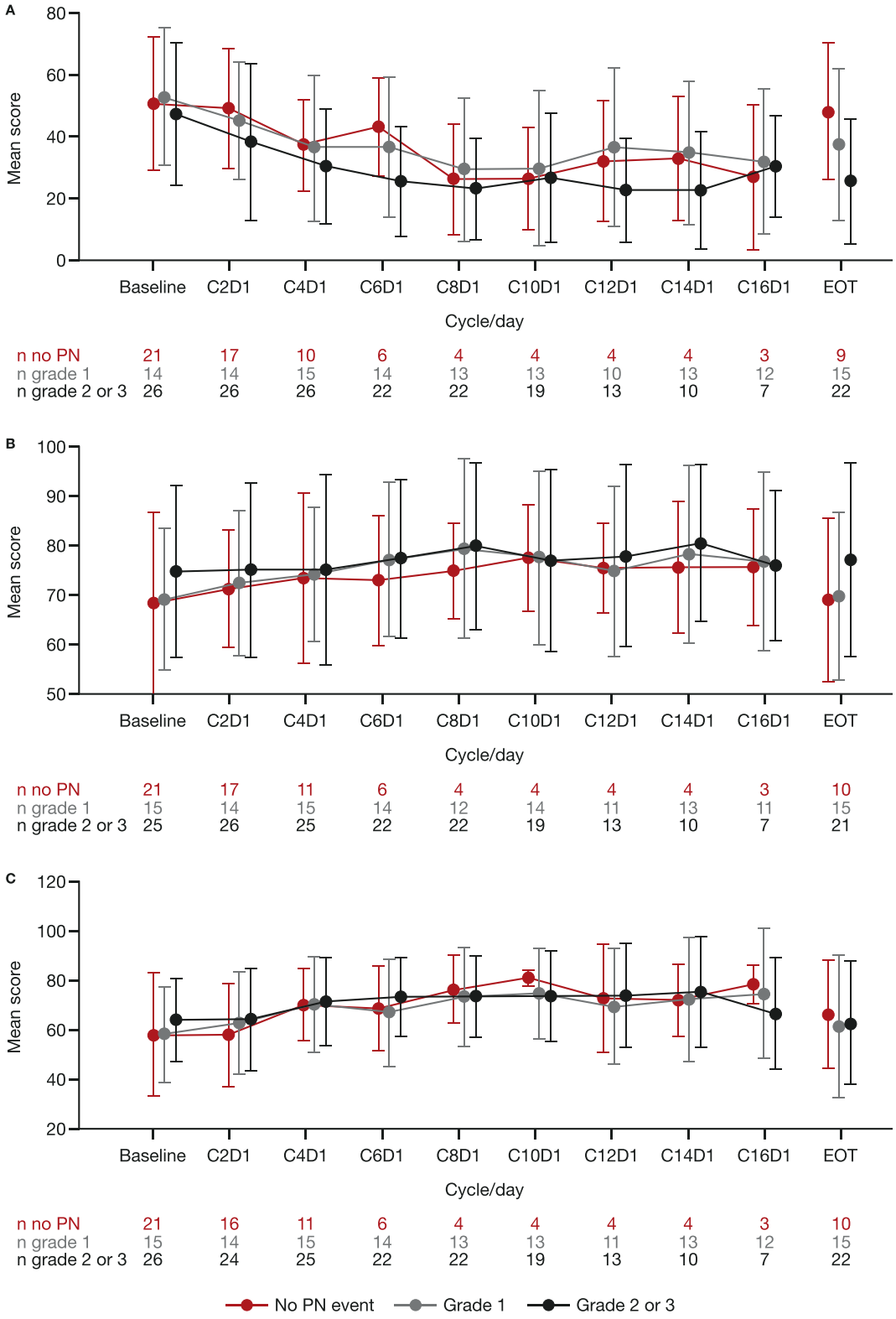

Fig. 4. Mean change from baseline in (A) Skindex-29 total score, (B) Functional Assessment of Cancer Therapy-General total score and (C) European quality of life 5-dimension visual analogue scale score over the course of treatment in the brentuximab vedotin arm in evaluable patients, according to maximum grade of PN (grade 1 versus grade 2 or 3 versus no PN). Bar represents mean ± standard deviation. C, cycle; D, day; EOT, end of treatment; PN, peripheral neuropathy.

in the Skindex-29 symptom domain. In addition, brentuximab vedotin did not adversely affect QoL compared with PC. QoL was also unaffected by the presence of PN in the brentuximab vedotin arm. In combination with the primary ALCANZA efficacy and safety data, the symptom burden and QoL findings provide compelling evidence supporting the use of brentuximab vedotin over methotrexate or bexarotene in previously treated CD30-expressing CTCL.

Funding sources

This research was co-funded by Millennium Pharmaceuticals, Inc., Cambridge, MA, USA, a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, and Seattle Genetics, Inc., Bothell, WA, USA, and was also funded in part through the NIH/NCI Cancer Center Support Grant [grant number P30 CA008748]. Medical writing assistance was funded by Millennium Pharmaceuticals, Inc.

Conflict of interest statement

S.W., P.W., J.A.S. and L.G. declare no conflicts of interest. R.D. reports intermittent, project-focused consulting and/or advisory relationships with Novartis, MSD, Bristol-Myers Squibb, Roche, Amgen, Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Pierre Fabre, Sun Pharma and Sanofi. H.M.P. reports consultancy, advisory roles or honoraria from Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Celgene and Eisai, and research funding from Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited. S.M.H. reports consultancy or advisory roles from Affimed, Aileron Therapeutics, Merck Sharp and Dome, Kyowa Hakko Kirin Pharma, Corvus Pharmaceuticals, Inc., Celgene, Portola Pharmaceuticals, Takeda Millennium, Innate Pharma, Verastem, Miragen Therapeutics, Inc. and Seattle Genetics, and research funding from ADCT Therapeutics, Aileron, Forty-Seven, Infinity/Verastem, Kyowa Hakko Kirin Pharma, Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Seattle Genetics, Inc., Celgene and Trillium. M.D. reports research funding and consultancy from Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, and Seattle Genetics, Inc. J.S. reports consultancy or advisory roles from Helsinn, Kyowa Hakko Kirin, Millennium Pharmaceuticals, Inc., Innate Pharma, 4SC and Mallinckrodt. P.Q. reports advisory roles from 4SC, Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Therakos, Innate Pharma and Kyowa Hakko Kirin. P.L.Z. reports consultancy, advisory and/or speakers bureau roles from Verastem, Celltrion, Gilead, Janssen-Cilag, Bristol-Myers Squibb, Servier, Sandoz, Merck Sharp & Dhome, Immune Design, Celgene, Portola, Roche, EUSA Pharma, Kyowa Hakko Kirin and Sanofi. H.E. reports consultancy or advisory roles from Genentech, Roche, AbbVie and Pharmacyclics, honoraria from Genentech, Roche, AbbVie, Pharmacyclics and Millennium Pharmaceuticals, Inc., and research funding from Genentech, Roche, AbbVie, Pharmacyclics, ATARA and Celgene. L.P.B. reports consultancy fees and honoraria from Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited. P.L.O.R. reports travel support from Janssen and Almirall, research support from MEDA, advisory roles from Takeda, Kyowa Hakko Kirin, Actelion, 4SC, Innate Pharma and MiRagen, and a patent on the clinical use of PLCG1 mutation detection. O.E.A. reports consultancy or advisory roles from Trillium Therapeutics and Bioniz, and research funding from Trillium Therapeutics and Pfizer. A.H. reports advisory board participation from Precision Oncology. J.W. reports an advisory role for Roche, Celgene, Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Janssen-Cilag, Servier, Amgen, Bristol-Myers Squibb, Incyte and Abbvie, research funding from Roche, GSK/Novartis, Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited and Janssen-Cilag, honoraria from Roche, Celgene, Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Janssen-Cilag and Servier, and conference travel support from Roche. Y.W., J.L., A.R. and J.F. report employment and stock ownership from Seattle Genetics, Inc. Y.Z., V.B., M.L., E.Z. and M.R.D. report employment from Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited. Y.H.K. reports honoraria from Eisai, Kyowa Hakko Kirin, Millennium Pharmaceuticals, Inc., Seattle Genetics, Inc., Medivir, Innate Pharma, Portola and Corvus, and research funding from Eisai, Kyowa Hakko Kirin, Merck Sharp & Dhome, Horizon, Millennium Pharmaceuticals, Inc., a wholly owned subsidiary of Takeda Pharmaceutical Company Limited, Seattle Genetics, Inc., Soligenix, MiRagen, Forty-Seven, Neumedicine, Innate Pharma, Portola, Trillium, Galderma and Elorac.

Acknowledgements

The authors acknowledge the writing assistance of Amy Watkins and Steve Hill of FireKite, an Ashfield company, part of UDG Healthcare plc, during the

development of this manuscript, which was funded by Millennium Pharmaceuticals, Inc., and complied with the Good Publication Practice 3 ethical guidelines [34].

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejca.2020.04.010.

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