Dose Modification Dynamics of Ponatinib in Patients With Chronic-Phase Chronic Myeloid Leukemia (CP-CML) From the PACE and OPTIC Trials

CML-046

Jane Apperley,[1] Hagop Kantarjian,[2] Michael Deininger,[3] Elisabetta Abruzzese,[4] Jorge Cortes,[5] Charles Chuah,[6] Daniel J DeAngelo,[7] John DiPersio,[8] Andreas Hochhaus,[9] Jeffrey H Lipton,[10] Franck Nicolini,[11] Javier Pinilla-Ibarz,[12] Delphine Rea,[13] Gianantonio Rosti,[14] Philippe Rousselot,[15] Michael Mauro,[16] Neil Shah,[17] Moshe Talpaz,[18] Alexander Vorog,[19] Xiaowei Ren,[19] Elias Jabbour[2]

[1]Imperial College London, United Kingdom; [2]The University of Texas MD Anderson Cancer Center, Houston, TX, USA; [3]Versiti Blood Research Institute, Milwaukee, WI, USA; [4]S. Eugenio Hospital, Tor Vergata University, Rome, Italy; [5]Georgia Cancer Center at Augusta University, Augusta, GA, USA; [6]Singapore General Hospital, Duke-NUS Medical School, Singapore; [7]Dana-Farber Cancer Institute, Boston, MA, USA; [8]Washington University School of Medicine, St. Louis, MO, USA; [9]Universitätsklinikum Jena, Jena, Germany; [10]Princess Margaret Cancer Centre, Toronto, Ontario, Canada; [11]Centre Léon Bérard, Lyon, France; [12]H. Lee Moffitt Cancer Center & Research Institute, Tampa, FL, USA; [13]Hôpital Saint-Louis, Paris, France; [14]IRCCS Istituto Romagnolo per lo Studio dei Tumori (IRST) "Dino Amadori", Meldola (FC), Italy; [15]Hospital Mignot University de Versailles Saint-Quentin-en-Yvelines, Paris, France; [16]Memorial Sloan Kettering, New York, NY, USA; [17]University of California San Francisco, San Francisco, CA, USA; [18]Comprehensive Cancer Center, University of Michigan, Ann Arbor, MI, USA; [19]Takeda Development Center Americas, Inc., Lexington, MA, USA

Introduction

- Ponatinib is the only approved pan-BCR::ABL1 inhibitor and the only third-generation TKI designed to potently inhibit BCR::ABL1 with or without any single resistance mutation, including T315I[1-3]
- In the Ponatinib Ph+ ALL and CML Evaluation (PACE) trial, patients with highly resistant CP-CML with substantial prior second-generation (2G) TKI treatment demonstrated deep, lasting responses to 45 mg once daily ponatinib[2]
  - PACE did not have a response-based dose-reduction strategy
- The phase 2 Optimizing Ponatinib Treatment In CP-CML (OPTIC) trial prospectively evaluated a response-based dose-reduction strategy in an attempt to optimize the dose schedule of ponatinib in patients with CP-CML whose disease was resistant to 2G BCR::ABL1 TKI therapy or with a T315I mutation[3]
  - OPTIC was designed with required dose reductions upon achievement of ≤1% *BCR::ABL1*[IS]

Methods

- The propensity score analysis was conducted to reduce potential bias from differences in baseline characteristics when comparing the TE-AOE incidence rates in PACE and OPTIC
- The propensity score calculation was adjusted for 14 parameters including baseline characteristics, disease parameters, and exposure

Results

Table 1. Demographics and Baseline Disease Characteristics

Characteristic	PACE CP-CML (N=270)[a]	OPTIC 45 mg → 15 mg (N=94)
Median age, y	60	46
Male gender, n (%)	144 (53)	50 (53)
Median time since diagnosis, y	7.03	5.5
Patients with CV risk factors, n (%)		
Hypercholesterolemia	65 (24)	3 (3.2)
Baseline BMI ≥30 kg/m^2	73 (27)	26 (28)
Diabetes mellitus	32 (12)	5 (5.3)
Vascular disorders	119 (44)	30 (32)
Arterial hypertension	102 (38)	29 (31)
Deep vein thrombosis	4 (1.5)	0
Concomitant medications, n (%)		
Statins	64 (24)	24 (26)
Acetylsalicylic acid	87 (32)	18 (19)
Best response to last prior TKI[b], n (%)		
CHR or worse	171 (63)	66 (70)
Better than CHR	99 (37)	28 (30)
BCR::ABL1 ratio at baseline[c,e], n (%)		
≤1% *BCR::ABL1*[IS]	6 (2.2)	3 (3.2)
>1%–10% *BCR::ABL1*[IS]	54 (20)	16 (17)
>10% *BCR::ABL1*[IS]	200 (74)	74 (79)
Mutations[f], n (%)		
No mutation	138 (51)	51 (54)
T315I	64 (24)	25 (27)
Mutation other than T315I	68 (25)	16 (17)
≥2 mutations detected	29 (11)	10 (11)
Stopped prior therapy due to resistance, n (%)	214 (84)[g]	92 (98)
Prior TKIs, n (%)		
1	18 (6.7)	1 (1.1)
≥2	252 (93)	93 (99)
≥3	162 (60)	50 (53)

[a]PACE: Includes 3 patients with CP-CML who were not T315I+ at study entry and not resistant to dasatinib or nilotinib. [b]OPTIC: Baseline response to last prior TKI is missing for 4 patients. [c]Sanger sequencing was used for mutation testing. [d]PACE: Four patients had an e1a2 variant, 4 had atypical transcripts, and 2 had missing data. [e]OPTIC: One patient in the 45-mg cohort does not have *BCR::ABL1*. [f]OPTIC: Two patients in the 45-mg cohort did not have any mutation testing performed at baseline. [g]Percentages were calculated according to the number of patients who received previous dasatinib or nilotinib: 256 patients with chronic-phase CML, 80 patients with accelerated phase CML, 61 patients with blast-phase CML, and 30 patients with Ph-positive ALL.

Objective

Here, we descriptively compared the potential impact of dosing differences between the 2 trials on efficacy and safety, as well as explored the impact of dosing differences on AOEs

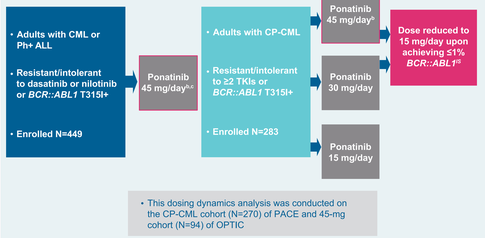
Figure 1. PACE and OPTIC Trial Designs[a]

PACE

- PACE (NCT01207440): A phase 2, single-arm study, of ponatinib in patients with CML or Ph+ ALL

OPTIC

- OPTIC (NCT02467270): A multicenter, randomized phase 2 trial characterizing the safety and efficacy of ponatinib

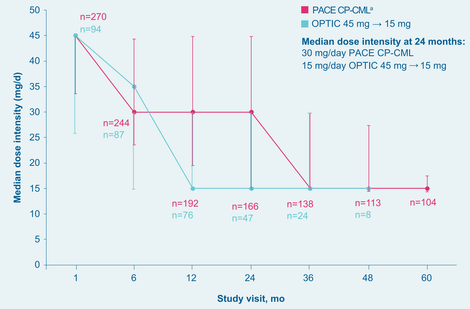


- This dosing dynamics analysis was conducted on the CP-CML cohort (N=270) of PACE and 45-mg cohort (N=94) of OPTIC

[a]In the PACE trial, AOEs were retrospectively adjudicated and in OPTIC AOEs were prospectively adjudicated. [b]In the PACE trial, proactive dose reductions were mandated in 2013: >2 years after initiation of the first patient. Patients who achieved MCyR had doses reduced to 15 mg once daily and those without MCyR had doses reduced to 30 mg once daily, unless benefit–risk analysis justified treatment with a higher dose. Dose reductions for adverse events also were permitted in PACE (to 15 mg). [c]The OPTIC trial was designed to incorporate a mandatory response-based dose-reduction strategy as described above; dose reductions for adverse events also were permitted (to 10–15 mg)

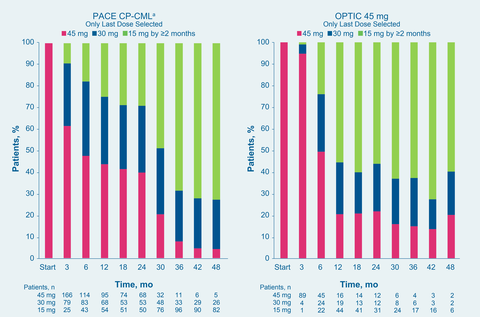
Results

Figure 2. Median Dose Intensity Over Time



[a]PACE: Includes 3 patients with CP-CML who were not T315I+ at study entry and not resistant to dasatinib or nilotinib

Figure 3. Change in Dose Over Time



[a]PACE: Includes 3 patients with CP-CML who were not T315I+ at study entry and not resistant to dasatinib or nilotinib

Key Takeaways

The response-based dose-reduction strategy in the OPTIC trial resulted in more rapid dose reductions, fewer dose reductions related to AEs, and longer median time on therapy in OPTIC compared with PACE, further demonstrating the benefit of the response-based dosing regimen used in OPTIC

Table 2. Dose Reductions and Dose Intensity in PACE and OPTIC

	PACE CP-CML (N=270)	OPTIC 45 mg → 15 mg (N=94)
Dose reduction		
Dose reduction due to AEs, n (%)	175 (65)	43 (46)
Dose reductions per FDA mandate or per protocol upon response[a], n (%)	46 (17)	33 (35)
No dose reductions, n (%)	49 (18)	19 (20)
Median time to dose reduction, mo	2.9	3.6
For safety	2.1	6.3
For efficacy	23.8	2.6

[a]Dose reductions in PACE were FDA-mandated after 2013 for safety concerns; for OPTIC, dose reductions were due to efficacy according to study design

- Efficacy outcomes were generally comparable or better in OPTIC when compared with PACE **(Figures 4–6, Table 3)**

Figure 4. Efficacy Outcomes in PACE and OPTIC by 12, 24, and 60 Months

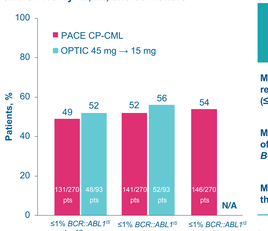
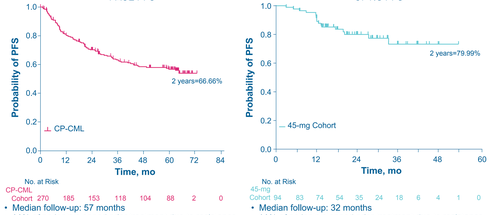


Table 3. Efficacy Outcomes in PACE and OPTIC

	PACE CP-CML (N=270)	OPTIC 45 mg → 15 mg (N=94)
Median time to response (≤1% *BCR::ABL1*[IS]), mo	5.6	6
Median duration of response (≤1% *BCR::ABL1*[IS]), mo	NR	NR
Median time on therapy, mo	12.6	19.5

- The preemptive dose adjustment in OPTIC led to longer time on therapy (19.5 mo vs 12.6 mo median time on therapy)

Figure 5. Progression-Free Survival[a,b]

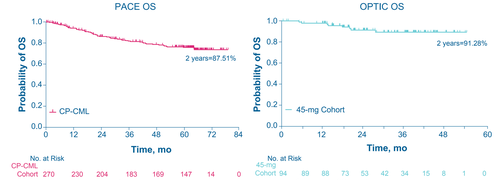


- Median follow-up: 57 months
- 96% of patients stopped prior treatment due to resistance

- Median follow-up: 32 months
- 98% of patients stopped prior treatment due to resistance

[a]Dose reductions in PACE were FDA mandated after 2013 for safety concerns; for OPTIC, dose reductions were due to efficacy according to study design. [b]Progression defined as progression of disease to accelerated phase or blastic phase CML.

Figure 6. Overall Survival



- Median follow-up: 57 months
- 96% of patients stopped prior treatment due to resistance

- Median follow-up: 32 months
- 98% of patients stopped prior treatment due to resistance

Safety

- The overall incidence of TEAEs was similar between the 2 trials, AOEs were substantially lower in OPTIC when compared with PACE **(Table 4, Figure 7)**
- Propensity score analyses comparing AOE incidence showed a reduction in relative risk for AOEs in OPTIC versus PACE **(Table 5)**

Table 4. Safety Summary for PACE and OPTIC

Safety Parameter	PACE CP-CML (N=270)	OPTIC 45 mg → 15 mg (N=94)
Any TEAE, n (%)	269 (100)	94 (100)
Grade 3/4	227 (84)	64 (68)

Figure 7. Exposure-Adjusted AOEs in PACE and OPTIC

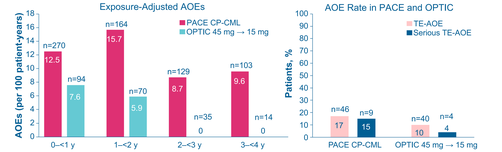


Table 5. Propensity Score Analysis Comparing AOE Incidence Between PACE and OPTIC

The propensity score analysis showed an overall risk reduction of 60% in OPTIC compared with PACE

Safety Parameter	PACE CP-CML (N=270)	OPTIC 45 mg → 15 mg (N=94)
Patients with AOE	61	9
Unadjusted AOE rate (95% CI)	0.2230 (0.1733, 0.2728)	0.0879 (0.0297, 0.1461)
Adjusted AOE rate		
Odds ratio (95% CI)		0.3288 (0.1499, 0.7212)
Relative risk (95% CI)		0.4066 (0.2060, 0.8027)

- The parameters accounted for in the propensity score analysis were:
  - Baseline systolic blood pressure, time since diagnosis, baseline ECOG PS, height at baseline, baseline weight, history of diabetes, mutation at baseline, geographic region, age, sex, race, ethnicity, total dose, total days on drug

Conclusions

- The response-based dose-reduction strategy in the OPTIC trial resulted in more rapid dose reductions, fewer dose reductions related to AEs, and longer median time on therapy in OPTIC compared with PACE, further demonstrating the benefit of the response-based dosing regimen used in OPTIC
- These data from the PACE and OPTIC trials suggest that treatment with a response-based dose-reduction strategy improves benefit:risk with comparable or better efficacy while mitigating risk of AEs/AOEs with ponatinib
  - After adjusting for differences in baseline characteristics, OPTIC showed an overall 60% risk reduction for AOEs compared with PACE
- Furthermore, this analysis supports the rationale to explore response-based dose-modification strategies for other BCR::ABL1 TKIs

References

1. Cortes JE, et al. N Engl J Med. 2013;369:1783-96. 2. Cortes JE, et al. Blood. 2018;132(4):393-404. 3. Cortes JE, et al. Blood. 2021; 138(21):2042-50.

Acknowledgments

We thank all the patients and their families, and the investigators and staff at all clinical sites, for their participation in the study.

This study is sponsored by Takeda Development Center Americas, Inc. The authors acknowledge Corey Burgin, PhD, of Peloton Advantage, LLC, an OPEN Health company, Parsippany, NJ, USA, for medical writing support for the development of this presentation under the direction of the authors, which was funded by Takeda Pharmaceuticals, USA, Inc., and complied with the Good Publication Practice 3 ethical guidelines (Battisti WP, et al. *Ann Intern Med*. 2015;163:461–4).

Abbreviations

2G, second-generation; AE, adverse event; ALL, acute lymphoblastic leukemia; AOE, arterial occlusive event; BMI, body mass index; CHR, complete hematologic response; CI, confidence interval; CML, chronic myeloid leukemia; CP-CML, chronic-phase chronic myeloid leukemia; CV, cardiovascular; d, day; ECG, electrocardiogram; ECOG PS, Eastern Cooperative Oncology Group performance status; FDA, US Food and Drug Administration; MCyR, major cytogenetic response; mo, month; N/A, not available; NR, not reached; OPTIC, Optimizing Ponatinib Treatment In CP-CML; OS, overall survival; PACE, Ponatinib Ph+ ALL and CML Evaluation; PFS, progression-free survival; Ph+, Philadelphia chromosome–positive; pts, patients; TEAE, treatment-emergent adverse event; TE-AOE, treatment-emergent AOE; TKI, tyrosine kinase inhibitor; y, year

Disclosures

JA: Honoraria, research funding, and speakers bureau (Incyte, Pfizer); honoraria and speakers bureau (Bristol Myers Squibb, Novartis); **HK:** Honoraria (AbbVie, Amgen, ARIAD, Bristol Myers Squibb, Immunogen, Orsenix, Pfizer, Agios, Takeda, Actinium Pharmaceuticals), research funding (all to institution: Pfizer, Amgen, Bristol Myers Squibb, Novartis, ARIAD, Astex Pharmaceuticals, AbbVie, Agios, Cyclacel, Immunogen, Jazz Pharmaceuticals); **MD:** Consultancy, membership on an entity's board of directors or advisory committees, part of a study management committee and research funding (Blueprint Medicines Corporation), consultancy (Fusion Pharma, Medscape, DisperSol), consultancy, membership on an entity's board of directors or advisory committees, and research funding (Takeda), consultancy and membership on an entity's board of directors or advisory committees (Sangamo), consultancy and research funding (Novartis), consultancy, honoraria, and research funding (Incyte), research funding (SPARC, DisperSol, Leukemia & Lymphoma Society); **EA:** Advisory board and consultancy (Incyte, Novartis, Pfizer), honoraria (Bristol Myers Squibb); **JC:** Consultancy and research funding (Bristol Myers Squibb, Daiichi Sankyo, Jazz Pharmaceuticals, Astellas, Novartis, Pfizer, Takeda, BioPath Holdings), research funding (Sun Pharma, Telios, Arog Pharmaceuticals, Merus, Immunogen), membership on an entity's board of directors or advisory committees (BioPath Holdings), consultancy (Amphivena Therapeutics, BioLineRx); **CC:** Honoraria (Novartis, Korea Otsuka Pharmaceutical, Otsuka [Philippines] Pharmaceutical, Steward Cross: Korea Otsuka International Asia Arab), honoraria (Novartis, Bristol Myers Squibb), travel and research funding (Pfizer); **DJD:** Consulting and advisory role (Amgen, Autolus, Blueprint Medicines, Forty-Seven, Gilead, Incyte, Jazz, Novartis, Pfizer, Servier, Takeda), research funding (all to institution: Novartis, AbbVie, GlycoMimetics, Blueprint Medicines); **JD:** Equity ownership (Magenta Therapeutics, WUGEN), board/advisory membership (RiverVest Venture Partners), research funding (Amphivena Therapeutics, NeoImmune Tech, Macrogenics, Incyte, BioLineRx, WUGEN), speaking fees (Incyte), patents/pending patents (CART with Washington University and WUGEN, VLA-4 inhibitors with Washington University and Magenta Therapeutics); **AH:** Research funding (Bristol Myers Squibb, Novartis, Pfizer, Incyte); **JHL:** Consultancy and research funding (Bristol Myers Squibb, ARIAD, Pfizer, Novartis); **FN:** Honoraria, speakers bureau, travel, accommodations, and expenses (Novartis, Incyte, Pfizer), consulting and advisory role (Sun Pharma, Novartis, Analysis Group, Kartos Therapeutics), research funding (all to institution: Incyte, Novartis), board entity (Novartis, Pfizer, Incyte); **JP-I:** Consulting and advisory role (AbbVie, Janssen, AstraZeneca, Novartis, TG Therapeutics, Takeda), speakers bureau (AbbVie, Janssen, AstraZeneca, Takeda), research funding (MEI, Sunesis), patents/royalties/other intellectual property (Sellas); **DR:** Steering committee (Novartis), advisory board (Incyte, Pfizer, Novartis); **GR:** Steering committee and advisory board (Novartis, Pfizer, Incyte), speakers bureau (Bristol Myers Squibb, Incyte, Novartis, Pfizer); **PR:** Consultancy and research funding (Incyte, Pfizer), consultancy (Bristol Myers Squibb, Novartis, Takeda); **MM:** Consultancy, honoraria, travel, accommodation, expenses, and research funding (Bristol Myers Squibb, Novartis, Takeda, Pfizer), research funding (Sun Pharma/SPARC); **NS:** Research funding (Bristol Myers Squibb); **MT:** Grant/research support (Takeda, Novartis); **AV:** Employment (Takeda); **XR:** Employment (Takeda); **EJ:** Research grants and advisory roles (AbbVie, Adaptive Biotechnologies, Amgen, Bristol Myers Squibb, Gerentech, Pfizer, Takeda)

Email for questions or comments: j.apperley@imperial.ac.uk

For an e-Print, scan this QR code.

Copies of this poster obtained through Quick Response (QR) Code are for personal use only and may not be reproduced without permission from the authors of this poster.

10th Annual Meeting of the Society of Hematologic Oncology, September 28–October 1, 2022, Houston, TX (Hybrid)