2. Zent CS, Wilson CS, Tricot G, et al. Oligoclonal protein bands and Ig isotype switching in multiple myeloma treated with high-dose therapy and hematopoietic cell transplantation. *Blood.* 1998;91(9):3518-3523.
3. Mark T, Jayabalan D, Coleman M, et al. Atypical serum immunofixation patterns frequently emerge in immunomodulatory therapy and are associated with a high degree of response in multiple myeloma. *Br J Haematol.* 2008;143(5):654-660.
4. Paiva B, Vidriales MB, Cerveró J, et al. Multiparameter flow cytometric remission is the most relevant prognostic factor for multiple myeloma patients who undergo autologous stem cell transplantation. *Blood.* 2008;112(10):4017-4023.
5. Ladetto M, Pagliano G, Ferrero S, et al. Correlation between clinical outcome and disease kinetics by quantitative PCR in myeloma patients following post-transplant consolidation with bortezomib, thalidomide and dexamethasone [abstract]. *Blood.* 2009;114(11):Abstract 960.

To the editor:

Role of GATA-1s in early hematopoiesis and differences between alternative splicing in human and murine *GATA-1*

We read with interest the description by Hoeller et al of an exon 2 *GATA-1* mutation leading to severe transient myeloproliferative disease (TMD),[1] in which the authors speculated that the severe phenotype might reflect loss of both full-length (FL) GATA-1 and the shorter isoform, GATA-1s, due to the position of the mutation in codon 2. Although almost all *GATA-1* mutations in children with Down syndrome are in exon 2[2-4] and lead to loss of GATA-1FL, exon 2 mutations are also predicted to leave GATA-1s protein production unaffected,[4] by translation of an alternatively spliced mRNA comprising exons 1/3/4/5/6.[2] In humans, alternative splicing producing an exon 1/2/3/4/5/6 mRNA for GATA-1FL and exon 1/3/4/5/6 splice variant for GATA-1s has been demonstrated in adult bone marrow $CD34^+$ cells.[2] Using exon 1 and 3 primers, we have also found that both variants are consistently expressed in all normal cord blood and second-trimester fetal liver and bone marrow cells we have tested (n = 12; Figure 1A). It seems likely, therefore, that exon 2 mutations would still allow expression of GATA-1s mRNA, which may be difficult to detect at the protein level due to the relative insensitivity of commercial GATA-1 antibodies in immunohistochemical reactions. Interestingly, and by contrast, although mice produce the 2 Gata-1 isoforms by alternative translation of a single mRNA,[5] Gata-1s transcripts have not been reported in murine tissues and, in our experience, exon 1 and 3 primers consistently amplify only the FL transcript in mice (Figure 1B) despite evidence of Gata-1s protein production (Figure 1C). Further investigation of the functional consequences of different *GATA-1* mutations may shed further light on the enigmatic role of GATA-1s in early hematopoiesis and differences between alternative splicing in human and murine *GATA-1*.

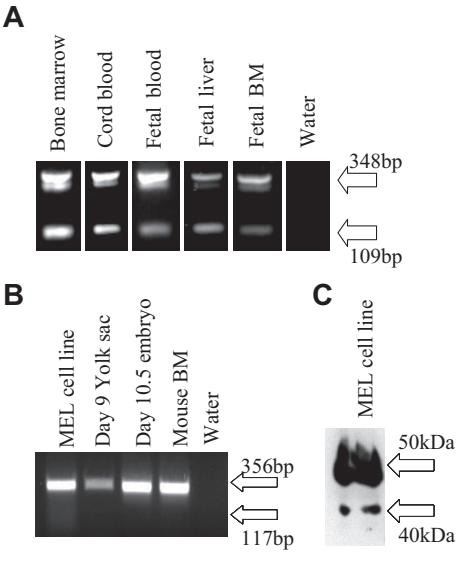

Figure 1. GATA-1 mRNA alternative splicing in human and murine tissues. (A) Reverse transcription–polymerase chain reaction (RT-PCR) of cDNA from human bone marrow, cord blood, and second-trimester (15 weeks) fetal blood, liver, and bone marrow, the expected size of the exon 1/2/3 splice variant (348 bp) and an exon 1/3 splice variant (109 bp) are marked. (B) RT-PCR of cDNA from murine hematopoietic tissues and the erythroleukemia cell line MEL. The expected size of an exon 1/2/3 splice variant (356 bp) and an exon 1/3 splice variant (117 bp) are marked. (C) Western blot of a MEL nuclear extract using M20 GATA-1 antibody (Santa Cruz Biotechnology), the predicted size of GATA-1FL is 47 kDa and GATA-1s 40 kDa.

Christina Halsey
Faculty of Medicine, University of Glasgow, Glasgow, United Kingdom

Oliver Tunstall
Department of Haematology, Imperial College London, London, United Kingdom

Brenda Gibson
Department of Paediatric Haematology, Royal Hospital for Sick Children, Glasgow, United Kingdom

Irene Roberts
Department of Haematology, Imperial College London, London, United Kingdom

Gerard Graham
Faculty of Medicine, University of Glasgow, Glasgow, United Kingdom

Acknowledgments: This work was supported by a Leukaemia Research Clinical Training Fellowship (C.H.) and a Kay Kendall Leukaemia Fund Junior Fellowship (O.T.). Approval was obtained from the Hammersmith and Queen Charlotte's Hospital Research Ethics Committee for these studies. Informed consent was provided according to the Declaration of Helsinki.

Contribution: C.H. performed the research and wrote the paper; O.T. performed the research and analyzed the data; and B.G., I.R., and G.G. designed the research and analyzed the data.

Conflict-of-interest disclosure: The authors declare no competing financial interests.

Correspondence: Dr Christina Halsey, Division of Immunology, Infection and Inflammation, University of Glasgow, Glasgow Biomedical Research Centre, 120 University Pl, Glasgow, G12 8TA, United Kingdom; e-mail: c.halsey@clinmed.gla.ac.uk.

References

1. Hoeller S, Bihl MP, Tzankov A, Kuehne T, Potthoff C, Bruder E. New GATA1 mutation in codon 2 leads to the earliest known premature stop codon in transient myeloproliferative disorder. *Blood.* 2009;114(17):3717-3718.
2. Rainis L, Bercovich D, Strehl S, et al. Mutations in exon 2 of GATA1 are early

events in megakaryocytic malignancies associated with trisomy 21. *Blood.* 2003;102(3):981-986.

3. Ahmed M, Sternberg A, Hall G, et al. Natural history of GATA1 mutations in Down syndrome. *Blood.* 2004;103(7):2480-2489.
4. Xu G, Nagano M, Kanezaki R, et al. Frequent mutations in the GATA-1 gene in the transient myeloproliferative disorder of Down syndrome. *Blood.* 2003; 102(8):2960-2968.
5. Calligaris R, Bottardi S, Cogoi S, Apezteguia I, Santoro C. Alternative translation initiation site usage results in two functionally distinct forms of the GATA-1 transcription factor. *Proc Natl Acad Sci U S A.* 1995;92(25):11598-11602.

To the editor:

Once- versus twice-weekly bortezomib induction therapy with CyBorD in newly diagnosed multiple myeloma

After observing high response rates in relapsed multiple myeloma (MM) patients,[1] we examined a 3-drug combination of bortezomib, cyclophosphamide, and dexamethasone (CyBorD) in newly diagnosed symptomatic patients. This phase 2 trial was open at Mayo Clinic Arizona and Princess Margaret Hospital, Toronto, was approved by the institutional review board/research ethics board of both centers, and was monitored by the Mayo Clinic Cancer Center Data and Safety Monitoring Board. Eligibility requirements were age 18 years or older, Eastern Cooperative Oncology Group performance status less than or equal to 2, Creatinine less than 3.5 mg/dL, absolute neutrophil count 1000/μL or more, platelets 100 000/μL or more, and informed signed consent. Patients had to have measurable disease. The primary end point of the study was confirmed response after 4 cycles (16 weeks). Responses were assessed according to modified EBMT criteria.[2]

The first 33 patients (cohort 1) received 300 mg/m^2 of cyclophosphamide by mouth on days 1, 8, 15, 22, 1.3 mg/m^2 of bortezomib intravenously on days 1, 4, 8 and 11, and 40 mg of dexamethasone by mouth on days 1 to 4, 9 to 12, and 17 to 20. As we reported,[3] the ORR (≥ PR) was 88%, with 61% VGPR or better. High-dose dexamethasone and bortezomib can both be associated with toxicities, treatment delays and discontinuation which may limit efficacy. To maximize dose delivery and reduce toxicity, we modified the original schedule and accrued 30 additional patients: cohort 2 received the same weekly cyclophosphamide schedule, 1.5 mg/m^2 of bortezomib intravenously on days 1, 8, 15, 22, and dexamethasone as in cohort 1 for cycles 1 and 2, then 40 mg once weekly for cycles 3 and 4.

Table 1. Overall response

ITT	Cohort 1 (n = 33)	Cohort 2 (n = 30)	All (n = 63)
ORR	88%	93%	90%
CR/nCR	39%	43%	41%
VGPR or better	61%	60%	60%
After 4 cycles	(n = 28)	(n = 27)	(n = 55)
ORR	96%	93%	95%
CR/nCR	46%	48%	47%
VGPR or better	71%	63%	67%
Toxicity			
Any ≥ Gr 3 AE	48%	37%	
Gr ≥ 3 Thrombocytopenia	21%	0%	
Gr ≥ 3 Neutropenia	12%	7%	
Gr ≥ 3 Anemia	9%	0%	
Gr ≥ 3 PN	6%	0%	
Any Gr PN	64%	57%	
Bortezomib doses reduced	21%	13%	
Dex dose reduced	30%	20%	

ITT indicates intention to treat; ORR, overall response; CR, complete response; nCR, near complete response; VGPR, very good partial response; GR, grade; AE, adverse event; and PN, peripheral neuropathy.

The trial required 30 patients in each cohort to test the null hypothesis that the true success proportion in this patient population is at most 20%.

Cohort 1 had more International Staging System stages II/III than cohort 2 (67% vs. 44%) but cohorts were otherwise comparable. The overall response (≥ PR) for all 63 patients is 90% with 41% CR/nCR and 60% VGPR or better (Table 1). For those completing all 4 cycles of therapy (n = 55), the ORR is 95% with 47% CR/nCR and 67% VGPR or better. Patients in the once weekly bortezomib cohort achieved responses similar to the twice weekly cohort (ORR 93% vs 88%, ≥ VGPR 60% vs 61%) and experienced less grade 3/4 adverse events (37%/3% vs 48%/12%). Fewer dose reductions of bortezomib and dexamethasone were required in the modified schedule and neuropathy rates were the same in both cohorts even though the total bortezomib dose per cycle was higher in the weekly versus the twice weekly schedule (6.0 mg/m^2 vs 5.2/mg/m^2).

CyBorD is a highly efficacious regimen and arguably as active as any 2- or 3-drug regimen reported to date.[4-7] We have had the ability to study 2 different dosing schedules of this combination and have shown both to be very active but one appears less toxic and is more convenient for the patient. A prospective, randomized, clinical trial to confirm these results seems warranted. The weekly bortezomib dosing with low-dose dexamethasone has become our preferred induction regimen for transplant eligible patients.

Craig B. Reeder
Hematology/Oncology, Mayo Clinic, Scottsdale, AZ

Donna E. Reece
Hematology/Oncology, Princess Margaret Hospital, Toronto, ON

Vishal Kukreti
Hematology/Oncology, Princess Margaret Hospital, Toronto, ON

Christine Chen
Hematology/Oncology, Princess Margaret Hospital, Toronto, ON

Suzanne Trudel
Hematology/Oncology, Princess Margaret Hospital, Toronto, ON

Kristina Laumann
Mayo Cancer Center Department of Biostatistics, Mayo Clinic, Rochester, MN

Joseph Hentz
Mayo Cancer Center Department of Biostatistics, Mayo Clinic, Rochester, MN