

## LETTER TO THE EDITOR

## Cyclophosphamide vs salvage chemotherapy plus G-CSF as chemo-mobilization in Asian patients undergoing autologous hematopoietic stem cell transplant

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Autologous hematopoietic stem cell transplantation (auto-HSCT) is the standard treatment option for multiple myeloma (MM) and relapsed non-Hodgkin's lymphoma (NHL) patients.<sup>1–3</sup> Granulocyte colony stimulating factor (G-CSF) combined with high-dose chemotherapy is a frequently used mobilization approach.<sup>2</sup> Chemo-mobilization success depends on the patient's age, apheresis timing, chemotherapy and immunomodulatory regimens as well as chemotherapy-related adverse events (AEs).<sup>3</sup> Mobilization failure leads to remobilization, which negatively impacts clinical outcomes and healthcare costs.<sup>4</sup>

We retrospectively analyzed 526 patients with MM ( $n=269$ ) and relapsed NHL ( $n=257$ ) undergoing stem cell collection after chemo-mobilization, in 14 centers in Asian Pacific countries, during 2009–2012. Among 269 MM patients, 235 (87.4%) received cyclophosphamide (CY) plus G-CSF and 34 (12.6%) were mobilized with other chemotherapeutic drugs (Table 1). Overall 232 MM patients (86.2%) achieved at least  $2 \times 10^6$  CD34+ cells/kg after 1–2 aphereses at initial mobilization. For MM patients who had received cyclophosphamide as a mobilizing agent, 223 (94.9%) had at least CD34+  $2 \times 10^6$  cells/kg and 182 patients (77%) achieved  $5 \times 10^6$  CD34+ cells/kg or higher (Table 1).

Among 257 NHL patients, 187 patients (72.8%) received salvage chemotherapy such as ICE ( $n=20$ ), RICE ( $n=21$ ), ESHAP ( $n=21$ ) and RDHAP ( $n=8$ ), and 70 patients (27.2%) received CY plus G-CSF (Table 1). Only 143 NHL patients (55.6%) achieved at least  $2 \times 10^6$  CD34+ cells/kg after 1–2 aphereses at initial mobilization. Administration of salvage regimens resulted in mobilizing at least  $2 \times 10^6$  CD34+ cells/kg in 172 NHL patients (92.0%) (Table 1). In 70 NHL patients, who received CY as a chemo-mobilizing agent, 53 patients (76%) achieved  $2 \times 10^6$  CD34+ cells/kg (Table 1).

Following chemo-mobilization and apheresis, a total of 242 MM patients (95.3%) and 178 NHL patients (79.1%), who achieved a minimum of  $2 \times 10^6$  CD34+ cells/kg, underwent HSCT. Overall, a higher population of MM patients was able to mobilize adequate numbers of stem cells for collection. The reasons for MM patients not proceeding to HSCT included patient withdrawal (5), being unfit for procedure (3), death (2) and disease progression (1). It is noteworthy that two patients had more than one reason. Of the 225 NHL patients who achieved at least  $2 \times 10^6$  CD34+ cells/kg, 5 patients died from a severe adverse event and 41 patients (18.2%) did not proceed to transplant because of patient withdrawal (20), disease progression (14) and being unfit for procedure (7).

This was the first study in an Asian Pacific population regarding the efficacy of chemo-mobilization of stem cells for auto-HSCT in MM and NHL patients. Cyclophosphamide plus G-CSF was the most appropriate combination to mobilize adequate number of stem cells in MM patients. By contrast, salvage chemotherapy plus G-CSF was more efficacious than cyclophosphamide for mobilizing stem cells in NHL patients. The majority of MM patients, mobilized with cyclophosphamide, and NHL patients receiving salvage chemotherapy, underwent auto-HSCT.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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S Issaragrisil<sup>1</sup>, T Cheng-Hwai<sup>2</sup>, U Bunworasate<sup>3</sup>,  
Y Su-Peng<sup>4</sup>, LY Hung<sup>5</sup>, GY Tee<sup>6</sup>, SFA Wahid<sup>7</sup>,  
NS Chin<sup>8</sup>, T Puavilai<sup>9</sup>, GG Gin<sup>10</sup>, KL Piu<sup>11</sup>, H Wen-Li<sup>12</sup>,  
C Tsai-Yun<sup>13</sup> and T Numbenjapon<sup>14</sup>

<sup>1</sup>Division of Hematology, Department of Medicine,  
Faculty of Medicine, Siriraj Hospital, Mahidol University,  
Bangkok, Thailand;

<sup>2</sup>Division of Hematology, Taipei Veterans General Hospital,  
Taipei, Taiwan;

<sup>3</sup>Division of Hematology, Department of Internal Medicine, Faculty of  
Medicine, King Chulalongkorn Memorial Hospital,  
Bangkok, Thailand;

<sup>4</sup>Division of Hematology and Oncology, China Medical University  
Hospital, Taichung, Taiwan;

<sup>5</sup>Department of Medicine, Queen Mary Hospital, Hong Kong;

<sup>6</sup>Department of Hematology, Singapore General Hospital, Singapore,  
Singapore;

<sup>7</sup>Department of Medicine, Faculty of Medicine, Cell Therapy Center,  
University Kebangsaan Malaysia Medical Center,  
Kuala Lumpur, Malaysia;

<sup>8</sup>Subang Jaya Medical Centre, Selangor, Malaysia;

<sup>9</sup>Division of Hematology, Department of Medicine, Faculty of  
Medicine, Ramathibodi Hospital, Mahidol University,  
Bangkok, Thailand;

**Table 1.** Impact of cyclophosphamide and other salvage regimens on mobilization of CD34+ cells

Apheresis outcomes	MM (N = 269)			NHL (N = 257)		
	CY-only N = 235	Other N = 34	P-value	CY-only N = 70	Other N = 187	P-value
$\geq 2 \times 10^6$ CD34+ cells	223 (95%)	31 (91%)	0.312	53 (76%)	172 (92%)	0.0005
$\geq 5 \times 10^6$ CD34+ cells	182 (77%)	20 (59%)	0.0165	23 (33%)	114 (61%)	0.00008

Abbreviations: CY = cyclophosphamide, Other = ICE ( $n=20$ ), RICE ( $n=21$ ), ESHAP ( $n=21$ ) and RDHAP ( $n=8$ ).

<sup>10</sup>Department of Medicine, Faculty of Medicine, University Malaya Medical Centre, Kuala Lumpur, Malaysia;

<sup>11</sup>Department of Haematology-Oncology, National University Hospital, Singapore, Singapore;

<sup>12</sup>Division of Hematology/Medical Oncology, Department of Medicine, Taichung Veterans General Hospital, Taichung, Taiwan;

<sup>13</sup>Department of General Medicine, Hematology and Oncology, National Cheng Kung University Hospital, Tainan, Taiwan and

<sup>14</sup>Division of Hematology, Department of Medicine, Phramongkutklo Hospital, Bangkok, Thailand  
E-mail: surapolsi@gmail.com

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