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Kinetics of CD34$^+$ cells or Colony forming-units for granulocyte/macrophage (CFU-GM) in Children Undergoing Apheresis

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Introduction

CD34$^+$ cells and CFU-GM are widely used in peripheral blood stem cell transplantation (PBSCT) as realistic markers for engraftment and corresponding threshold numbers are determined.[1,2] However, precise evaluation of the kinetics of these parameters during collection of PBSC by apheresis (AP) has not been reported. In this study, serial samplings of patients' blood were taken during the initial AP to examine the changes in the level of CD34$^+$ cells or CFU-GM. Examination of collection efficiency (CE) was also performed.

Patients and Methods

A total of 31 AP were performed in 16 patients (age, 10 mo to 17 yr; median, 5 yr) with various types of malignant disorders. The dignosis included 6 acute lymphoblastic leukemia, 5 neuroblastoma, 2 brain tumor, 1 Hodgkin's lymphoma, 1 yolk sac tumor and 1 lung sarcoma. Four normal donors for allogeneic PBSCT were also examined. Two mobilization methods, i.e., combined chemotherapy and granulocyte colony-stimulating factor (G-CSF) (50-300 μ g/m^2/day i.v.d.) or G-CSF alone (10 μ g/m^2/day s.c.) for 5 days were used. A continuous-flow cell separator (CS3000 Plus, Fenwal Laboratory, Dearfield, IL) was operated for 3 hours during the marrow recovery phase, with a small-volume collection chamber.[3] In the first AP performed with individual patients, 5-mL blood samples were collected via a central line for every 50 mL/kg or 2000 mL of processed blood. Then, circulating levels of CD34$^+$ cells and CFU-GM were evaluated, and each level was shown as a percentage of the pre-apheresis value. The tested population was grouped according to age, i.e., below 1 yr, 2 to 10, 11 to 20 and adult donors, and each group consisted of 4 persons. The mean body weight was 9, 18, 55 and 72 kg, respectively. The central line was not used for AP. CE was calculated in all AP, using the following formula: [Total number of target cells collected by AP]/[Pre-AP number of target cells (/L blood) x blood processed (L)].

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Results

In age below 1 yr group, a prompt increase of both $CD34^+$ cells and CFU-GM levels was triggered by AP in all tested infants. Although followed by a gradual decrease, this increased level continued to be present to the end of AP. In patients aged 2 to 10 yr, $CD34^+$ cells and CFU-GM appeared to be slightly elevated during the initial phase of AP. Meanwhile, in most patients, the levels gradually decreased below the pre-AP value. In patients aged 11 to 20 yr, $CD34^+$ cell levels uniformly decreased, but the change in the CFU-GM level was variable. In adult donors, both parameters decreased immediately after the start of AP.

CEs with the CFU-GM parameter ranged from 1% to 137%, with a mean of 47%. That with the $CD34^+$ cell parameter ranged from 4% to 235%, with a mean of 70%. A significant correlation was found by Spearman's rank correlation coefficient analysis between CEs calculated by these two parameters ($p<0.01$).

Conclusion

In our analysis, kinetics of circulating stem/progenitor cells during AP was age dependent. In infants more cells are mobilized by AP itself, while cells continue to decrease as AP goes on in older populations. We speculate that this is because various cytokines are secreted into blood during AP, to which stem/progenitor cells from infants are more sensitive than those from their older counterparts. Actually, more stem/progenitor cells were collected by initial AP in younger patients than in older ones.

Reliable evaluation of CE is possible by using the $CD34^+$ cell- or CFU-GM-parameter. However, there were wide patient-to-patient variations in the serial changes of these parameters during AP, making the use of this factor unrealistic to determine the ideal target volume of blood for processing. Hence, we think that further examinations will be needed to establish the optimal duration of AP.

References

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