Comparison of two leukapheresis programs for computerized collection of blood progenitor cells on a new cell separator

N. Schwella, K. Movassaghi, S. Scheding, N. Ahrens, and A. Salama

BACKGROUND: Peripheral blood progenitor cells (PBPCs) can be collected on various cell separators. Two leukapheresis programs (LP-MNC and LP-PBSC-Lym) were evaluated for computerized collection of PBPCs on a new cell separator.

STUDY DESIGN AND METHODS: Leukapheresis assisted by the LP-MNC or LP-PBSC-Lym software was performed for the harvesting of PBPCs in 52 oncology patients after chemotherapy plus G-CSF treatment and in 18 healthy subjects after G-CSF mobilization alone.

RESULTS: A total of 38 components from 33 donors via LP-MNC and 43 components from 37 donors via LP-PBSC-Lym were collected with a median of one (range, one to two) standard-volume leukapheresis procedures (9.2-13.3 L) per donor. There were no significant differences between the two groups concerning median counts of WBCs, CD34+ cells, CD34+ cell yields per harvest, and CD34+ cell yields of cumulative harvests. The blood cell counts after leukapheresis revealed that the LP-MNC resulted in significantly higher platelet loss than LP-PBSC-Lym (p = 0.024): 35.9 percent (range, 19.2%-66.1%) versus 29.7 percent (11.6%-52.3%). Regarding the CD34+ cell collection efficiency, the LP-MNC program was significantly better than the LP-PBSC-Lym program (p < 0.001): 77.5 percent (range, 35.5%-98.9%) versus 58.3 percent (range, 20.4%-98.9%). However, concentrates collected by the LP-PBSC-Lym program had significantly higher percentages of MNCs (p < 0.001) and CD34+ cells (p = 0.028) than harvests with the LP-MNC program: 90 percent (range, 69%-99%) versus 70 percent (range, 35%-98%) and 1.2 percent (range, 0.2%-7.3%) versus 0.7 percent (range, 0.2%-6.0%), respectively. No leukapheresis-related serious adverse events were seen, and time for hematopoietic engraftment was equivalent to data published in the literature.

CONCLUSION: The LP-MNC program shows a significantly better CD34+ cell collection efficiency than the LP-PBSC-Lym program. However, collections with the LP-MNC program result in PBPC components with a lower MNC and CD34+ cell concentrations and a higher apheresis-related loss of patient’s platelets.

Mobilized peripheral blood (PB) progenitor cells (PBPCs) collected by leukapheresis have largely replaced marrow cells as the source of hematopoietic rescue in autologous and allogeneic PBPC transplantation.1-3 Circulating PBPCs (CD34+ cells) are rare in steady state, but their frequency increases markedly after chemotherapy-induced myelosuppression and/or administration of hematopoietic growth factors.5-8 The combination of cytotoxic chemotherapy plus growth factors is an effective way to mobilize autologous CD34+ cells from the marrow into the blood stream.9,10 Since autotransplantation with nonmobilized PBPCs has been associated with delayed engraftment, autologous hematopoietic rescue is usually performed with CD34+ cells mobilized by chemotherapy plus growth factors.11-13 In allogeneic PBPC transplantation, healthy subjects undergo steady-state mobilization with growth factors alone.14 The PBPCs are harvested by leukapheresis, a continuous or discontinuous closed-circuit blood separation procedure that allows the collection of MNCs, the blood cell fraction that potentially contains HPCs and hematopoietic stem cells.15,16 Leukapheresis can be performed with a variety of apheresis systems.17-26

A new cell separator was recently introduced (COM.TEC, Fresenius HemoCare, Bad Homburg, Germany). Actually, a single report exists on platelethapheresis

ABBREVIATIONS: BC = buffy coat; CD34-CE(s) = CD34+ cell collection efficiency(-ies); LP(s) = leukapheresis program(s); PB = peripheral blood; PBPC(s) = peripheral blood progenitor cell(s); PLT(s) = platelet(s).

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with the COM.TEC, but there is no published study concerning PBPC harvesting. In this prospective study, the evaluation of the COM.TEC cell separator with the computerized leukapheresis programs (LPs) MNC and PBSC-Lym focused on the machine’s cell separation characteristics, on donor status before and after collection, on the CD34+ cell collection efficiency (CD34-CE), on concentrate characteristics, and on monitoring of the leukapheresis-related adverse events and the time of hematopoietic engraftment.

**MATERIALS AND METHODS**

**Donors**

The donors consisted of 52 oncology patients scheduled for PBPC autografting and of 18 healthy subjects for allogeneic PBPC donation (Table 1). They gave their informed consent regarding the mobilization and collection of circulating CD34+ cells.

**Mobilization of PBPCs**

In the oncology patients, mobilization of PBPCs was performed with various disease-specific chemotherapy regimens plus hematopoietic growth factors. One day after completion of chemotherapy, the patients received 5 to 10 μg per kg per day G-CSF (Neupogen, Amgen, München, Germany) by the subcutaneous route. The healthy subjects underwent PBPC mobilization by subcutaneous G-CSF alone at 10 μg per kg per day. G-CSF was administered until completion of leukapheresis.

**Collection of PBPCs**

By use of the COM.TEC cell separator, a total of 38 collections were obtained from 33 donors via the LP-MNC program, and 43 harvests were obtained from 37 donors via the LP-PBSC-Lym program. The dual-needle leukapheresis kits of the LP-MNC and LP-PBSC-Lym programs were installed and primed according to the manufacturer’s instructions. ACD-A (Fresenius HemoCare) was used as anticoagulant at a ratio of 1 in 10 to whole blood.

A total volume of 9.2 to 13.3 L (median, 12.0 L) was processed at a flow rate of 45 to 65 mL per minute.

Both LPs run with a continuous blood flow and a cyclical collection of MNCs, but require disposables with a different geometry of the separation chamber. At the start of leukapheresis, the donor’s sex, body weight, height, and Hct and WBC counts are entered into the machine. The software calculates based on the individual WBC count of the donor the exact PB volume (separation cycle) that must be processed before every buffy coat (BC) collection cycle and, furthermore, the volumes of the spillover phase and the BC phase. Thus, the MNCs are cyclically collected at the end of each individually determined separation cycle (300-600 mL). Nevertheless, when appropriate, the volume of the separation cycle, the spillover, and BC volumes can be adjusted by the operator during the leukapheresis procedure.

The LP-MNC program works with a one-stage chamber (PI1 leukapheresis kit, Fresenius HemoCare). One separation cycle consists of three phases:

1. Separation phase: Anticoagulated PB enters the separation chamber and is separated into RBCs, BC, and platelet (PLT)-rich plasma. During the separation cycle, the RBCs (outer side of the separation chamber) are continuously returned to the donor via the RBC port, and the PLT-rich plasma (inner side of the chamber), via the plasma port. While RBCs and PLT-rich plasma are running back to the donor, the WBCs accumulate as a BC in the separation chamber. The BC position is controlled by an optical interface monitor. When the preset separation cycle volume has been reached, the blood flow is reduced to concentrate the BC.

2. Spillover phase: The plasma pump transfers the BC into the plasma port of the separation chamber by pumping a preset plasma volume (spillover volume).

3. BC phase: The plasma pump is stopped and the BC is pumped by the cell pump into the collection bag (BC volume).

The LP-PBSC-Lym program works with a two-stage chamber (C4Y leukapheresis kit, Fresenius HemoCare). One separation cycle consists of four phases:

1. Separation phase: Anticoagulated PB enters the first stage of the separation chamber, and while RBCs and PLT-rich plasma are continuously returned to the donor, the BC cells accumulate in the optically controlled interphase.

2. Spillover phase: The plasma pump transfers the BC into the second stage of the chamber by a preset plasma volume (spillover volume).

3. Waiting phase: The BC cells are concentrated at the cell port of the second stage of the chamber, while the interphase is reestablished in the first stage.

4. BC phase: After the waiting phase the cell pump
starts to transfer the BC into the collection bag (BC volume).

Cryopreservation of autologous PBPCs

The PBPC components were centrifuged for 10 minutes at 2000 rpm, resuspended in autologous plasma, frozen in cryopreservation bags (Baxter, Unterschleissheim, Germany) with 10 percent DMSO (final component volume, 100-110 mL) with an automated controlled-rate freezer (Cryo10, Messer Griesheim, Düsseldorf, Germany), and stored in liquid nitrogen.

Laboratory analysis

Blood cell counts were performed with an electronic counter (NE7000, TOA Sysmex, Kobe, Japan), and the percentage of MNCs was determined microscopically by counting of 200 WBCs with Wright-Giemsa-stained PB smears. All WBCs except neutrophils, bands, basophils, and eosinophils were defined as MNCs. The CD34+ cells were analyzed by flow cytometry from PB samples and PBPC concentrates before and after leukapheresis, as described previously. The total number of harvested CD34+ cells was calculated by multiplying the measured CD34+ cell count per µL with the total volume (mL) of the leukapheresis product and adjusted to the recipient’s body weight (kg). If appropriate, results of single collections were added to obtain the total CD34+ cell dose for the graft recipient. Cell viability was analyzed from frozen-thawed satellite samples by trypan blue exclusion. For microbiologic analysis, samples were taken from the leukapheresis products before freezing, as described elsewhere.

CD34-CE

The CD34-CE was calculated with the formula:

\[ \text{CD34-CE} \times 100 = \frac{(\text{total number of CD34+ cells collected per leukapheresis})}{(\text{total volume processed} - \text{ACD-A volume})} \times 1000 \]

Transplantation of PBPCs

Following high-dose radiotherapy and/or chemotherapy, patients underwent PBPC transplantation. Allogeneic products were transfused to the recipients without further ex vivo manipulation on the day of collection. The cryopreserved autologous concentrates were thawed in a water bath at 40°C and then returned to the patients through a central venous line. The day of transfusion or return of PBPC transplants was designated as Day 0. Time to hematopoietic engraftment was defined as the day after transplantation with an absolute neutrophil count of > 500 per µL and an unsupported PLT count of > 20,000 per µL.

Statistical analysis

The data were analyzed on a personal computer by use a software package (Statistica, Statsoft, Tulsa, OK). The U-test was used to compare continuous variables of two groups and the Wilcoxon test was used for the comparison of dependent variables within a group. Differences with p < 0.05 were considered to be significant.

RESULTS

Leukapheresis

Donors underwent a median of one (range, one to two) standard-volume leukapheresis procedures with 12.0 L (range, 9.2-13.3 L) on the COM.TEC cell separator. Both groups, LP-MNC (33 donors with a total of 38 procedures) and LP-PBSC-Lym (37 donors with a total of 43 procedures), had comparable WBC and CD34+ cell counts in the PB before leukapheresis, as described previously. The total number of harvested CD34+ cells was calculated by multiplying the measured CD34+ cell count per µL with the total volume (mL) of the leukapheresis product and adjusted to the recipient’s body weight (kg). If appropriate, results of single collections were added to obtain the total CD34+ cell dose for the graft recipient. Cell viability was analyzed from frozen-thawed satellite samples by trypan blue exclusion. For microbiologic analysis, samples were taken from the leukapheresis products before freezing, as described elsewhere.

<table>
<thead>
<tr>
<th>TABLE 2. Leukapheresis with programs LP-MNC and LP-PBSC-Lym</th>
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<tbody>
<tr>
<td>Number of leukapheresis procedures per donor</td>
</tr>
<tr>
<td>Total blood volume processed per leukapheresis (L)</td>
</tr>
<tr>
<td>Number of WBCs before leukapheresis (×10⁶/µL)</td>
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<tr>
<td>Number of CD34+ cells before leukapheresis (per µL)</td>
</tr>
<tr>
<td>Number of CD34+ cells per kg (×10⁶) (single harvests)</td>
</tr>
<tr>
<td>Number of CD34+ cells per kg (×10⁶) (cumulative harvests)</td>
</tr>
</tbody>
</table>

* Data are shown as medians; ranges are in parentheses. † U-test.
Laboratory analysis before and after leukapheresis

Patients’ Hb values, numbers of PLTs, and CD34+ cell counts decreased significantly during leukapheresis with both LPs (Table 3).

Leukapheresis concentrates

The concentrates collected by the LP-MNC program had a significantly higher median number of total nucleated cells than those obtained by the LP-PBSC-Lym program: 534.6 × 10^8 versus 251.2 × 10^8. The leukapheresis products harvested by the LP-PBSC-Lym program, however, had in median significantly higher percentages of MNCs and CD34+ cells than those harvested by the LP-MNC program: 90 percent versus 70 percent and 1.2 percent versus 0.7 percent, respectively. Hct and PLT counts were not significantly different between PBPC concentrates obtained by the LP-MNC and LP-PBSC-Lym programs (Table 4).

CD34-CE

The median CD34-CE of the LP-MNC program was significantly better than the CD34-CE of the LP-PBSC-Lym program: 77.5 percent versus 58.3 percent (p < 0.001). Furthermore, the CD34-CE of the LP-MNC program was significantly higher below and above the threshold of 40 CD34+ cells per µL than that of the LP-PBSC-Lym program: 80.9 percent versus 63.9 percent (CD34+ cells < 40/µL) and 71.8 percent versus 53.7 percent (CD34+ cells ≥ 40/µL), respectively. Nevertheless, in both groups, the CD34-CE was better at lower PB CD34+ cell counts than at higher CD34+ cell numbers (CD34+ cells < 40/µL vs. ≥ 40/µL): 80.9 percent versus 71.8 percent for the LP-MNC program and 63.9 percent versus 53.7 percent for the LP-PBSC-Lym program (Table 5).

Adverse events

Mild to moderate citrate reactions (perioral/limb paresthesias) were observed during 20 collections (24.7%). All reactions were managed by adjusting the ACD-A to PB ratio from 1 in 10 up to 1 in 14, by a slower blood flow per minute, and/or by supplementation of oral calcium. No severe adverse reactions were observed; specifically, no hemolysis occurred and no patient required intravenous calcium and/or discontinuation of the collection procedure.

Transplantation of PBPCs

All allogeneic components were freshly transfused on the day of collection to the recipients (n = 18), and cryopreserved and thawed autologous concentrates were returned to 35 patients. Medians of transfused and returned cell doses were 6.3 × 10^8 MNCs per kg (range, 4.0 × 10^8-11.7 × 10^8 MNCs/kg) and 6.1 × 10^8 CD34+ cells per kg (range, 3.1 × 10^8-32.1 × 10^8 CD34+ cells/kg) for allogeneic transplantation and 3.5 × 10^8 MNCs per kg (range, 1.1 × 10^8-13.2 × 10^8 MNCs/kg) and 5.0 × 10^6 CD34+ cells per kg (range, 2.1 × 10^6-31.6 × 10^6 CD34+ cells/kg) for autologous transplantation. Engraftment times for allogeneic and autologous PBPCs to achieve more than 500 neutrophils per µL and more than 20,000 PLTs per µL were equivalent to data published in the literature. Results of autologous engraftment were

### Table 3. Comparison of patient’s laboratory analysis before and after leukapheresis with programs LP-MNC and LP-PBSC-Lym

<table>
<thead>
<tr>
<th></th>
<th>Before apheresis*</th>
<th>After apheresis*</th>
<th>p†</th>
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</thead>
<tbody>
<tr>
<td><strong>LP-MNC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hb (g/dL)</td>
<td>11.3 (7.1-15.4)</td>
<td>10.1 (6.2-14.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PLTs (x10^3/µL)</td>
<td>89 (12-316)</td>
<td>56 (9-159)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CD34+ cells per µL</td>
<td>56.4 (15.2-787.9)</td>
<td>42.1 (8.8-615.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>LP-PBSC-Lym</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hb (g/dL)</td>
<td>10.4 (6.6-14.7)</td>
<td>9.7 (5.9-13.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PLTs (x10^3/µL)</td>
<td>116 (16-384)</td>
<td>79 (12-251)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CD34+ cells per µL</td>
<td>58.8 (7.2-510.8)</td>
<td>41.0 (5.9-279.0)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* Data are shown as medians; ranges are in parentheses. † Wilcoxon test.

### Table 4. Concentrate characteristics collected with leukapheresis programs LP-MNC and LP-PBSC-Lym

<table>
<thead>
<tr>
<th></th>
<th>LP-MNC*</th>
<th>LP-PBSC-Lym*</th>
<th>p†</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBCs (x10^9)</td>
<td>534.6 (192.2-1364.2)</td>
<td>251.2 (84.5-589.8)</td>
<td>0.002</td>
</tr>
<tr>
<td>MNCs (%)</td>
<td>70 (35-98)</td>
<td>90 (69-99)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CD34+ cells (%)</td>
<td>0.7 (0.2-6.0)</td>
<td>1.2 (0.2-7.3)</td>
<td>0.028</td>
</tr>
<tr>
<td>Hct (%)</td>
<td>6.7 (2.2-11.6)</td>
<td>5.4 (4.5-8.6)</td>
<td>NS</td>
</tr>
<tr>
<td>PLTs (x10^11)</td>
<td>1.8 (0.2-8.9)</td>
<td>1.7 (0.3-4.9)</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Data are shown as medians; ranges are in parentheses. † U-test.

### Table 5. CD34-CE of leukapheresis programs LP-MNC and LP-PBSC-Lym according to PB CD34+ cell counts

<table>
<thead>
<tr>
<th></th>
<th>LP-MNC*</th>
<th>LP-PBSC-Lym*</th>
<th>p†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall (n = 81)</td>
<td>77.5 (35.5-98.9)</td>
<td>58.3 (20.4-98.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CD34+ cells &lt;40 per µL (n = 30)</td>
<td>80.9 (48.3-98.9)</td>
<td>63.9 (54.8-98.9)</td>
<td>0.006</td>
</tr>
<tr>
<td>CD34+ cells ≥40 per µL (n = 51)</td>
<td>71.8 (35.5-96.2)</td>
<td>53.7 (20.4-77.7)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* Data are shown as median percentages; ranges are in parentheses. † U-test.
also equivalent to neutrophil and PLT recovery seen by
the authors with PBPCs collected by other cell separators
(COBE Spectra, Gambro BCT, Planegg-Martinsried, Ger-
many; or AS104, Fresenius HemoCare: median times to
achieve neutrophils > 500 per μL and PLTs > 20,000 per
μL, 10 and 11 days, respectively).26,35

## DISCUSSION

The present study demonstrated that both LPs for com-
puter-assisted leukapheresis ensure effective collection
of allogeneic and autologous PBPCs on the COM.TEC cell
separator. Each donor required only one to two standard-
volume leukapheresis procedures (9.2-13.3 L) to obtain a
sufficient hematopoietic autograft (≥ 2.0 × 10^6 CD34+
cells/kg) or allograft (≥ 3.0 × 10^6 CD34+ cells/kg). The
LP-MNC program showed a significantly better CD34-CE
(77.5%) than the LP-PBSC-Lym program (58.3%). Both
LPs showed an inverse correlation between circulating
CD34+ cell numbers and CD34-CEs, a phenomenon that
we have recently described (Table 5).36 In contrast, the
concentrates collected by the LP-PBSC-Lym program had
significantly higher percentages of MNCs (90% vs. 70%)
and CD34+ cells (1.2% vs. 0.7%) than those harvested by
the LP-MNC program. The median Hct and PLT counts of
the leukapheresis products were not significantly differ-
ent (LP-MNC vs. LP-PBSC-Lym): 6.7 percent versus 5.4
percent and 1.8 × 10^11 versus 1.7 × 10^11, respectively,
ranking within values already described for the AS104.20
Both LPs resulted in a significant leukapheresis-related
decrease of patient’s Hb (PB counts before leukapheresis
vs. after leukapheresis), as reported for other cell separa-
tors: 11.3 g per dL versus 10.1 g per dL (LP-MNC) and 10.4
g per dL versus 9.7 g per dL (LP-PBSC-Lym).23-25 This
finding might be due to the RBC loss into the PBPC con-
centrate and into the separation chamber of the machine.
PBPC harvesting also resulted in a significant decrease of
patient’s PLT counts: 89 × 10^3 per μL versus 56 × 10^3 per
μL (LP-MNC) and 116 × 10^3 per μL versus 79 × 10^3 per
μL (LP-PBSC-Lym). The procedure-related PLT loss was
significantly higher by the LP-MNC program (35.9%) than
the LP-PBSC-Lym program (29.7%), a fact, however, that
could be biased by the different PLT counts before leu-
kaheresis.

There are limited amounts of data in the literature
concerning the processing of marrow grafts and the har-
esting of PBPCs on the Fresenius cell separators AS104
and AS.TEC204.18,20,22,26-39 Leibundgut et al.18 (AS104)
and Moog et al.39 (AS.TEC204) reported on the CD34+ cell
dose collected, but they provided no data concerning the
CD34-CEs and the MNC/CD34+ cell percentages of the
congentrates collected. Bambi and colleagues,22 who
used the LP-PBSC-Lym software on the AS104 to obtain
24 PBPC harvests from pediatric patients, achieved a
mean CD34+ cell extraction efficiency of 42 percent and
a MNC percentage of 78 percent in the harvested com-
ponents. These figures are somewhat lower than those
that we obtained by the LP-PBSC-Lym program on the
COM.TEC. This difference might be due to the older soft-
ware version of the AS104. The leukapheresis-related loss
of patient’s PLTs (16.0%) reported by Bambi et al.22 is
lower than the PLT loss (29.7%) observed in the present
study, which is probably related to differences in the total
volume processed (medians, 2.1 L vs. 12.0 L). Menichella
and coworkers20 evaluated the LP-MNC (73 harvests) and
LP-PBSC-Lym (61 harvests) programs on the AS104. They
also observed a remarkable difference concerning the
CD34-CE: 62.4 percent (LP-MNC) versus 31.7 percent
(LP-PBSC-Lym). The significant difference between the
two LPs is in agreement with our results, because a sig-
ificantly better CD34-CE with LP-MNC was also ob-
tained (p < 0.001). However, the COM.TEC achieved higher
CD34-CEs with both programs than the AS104 in the
study by Menichella et al.20 This could be due to the
different modes of operation of the two cell separators.
The AS104 processes, irrespective of the patient’s WBC
count, a fixed blood volume before the MNCs are cycli-
cally collected with a fixed BC volume. In contrast, the
software of the COM.TEC calculates the blood volume to
be processed per separation cycle and the volume of the
BC based on the individual WBC count of the donor be-
fore leukapheresis. Menichella et al.20 detected a signifi-
cantly higher RBC contamination in the concentrates col-
lected by the LP-MNC procedure. However, our results
showed no significant difference concerning the RBC
contamination of the concentrates obtained by the LP-
MNC or LP-PBSC-Lym program. This difference between
the findings of Menichella et al.20 and our group may be
related to the above-mentioned technical features of the
machines. During leukapheresis, a significant loss of
PLTs occurred with both programs used on the COM.TEC.
The median PLT loss was significantly higher with the LP-MNC program than with the LP-PBSC-Lym
program, but remained within ranges reported for other
cell separators.22-24 The greater PLT loss by the LP-MNC
program, however, did not result in a higher PLT con-
tamination in the PBPC concentrates, compared to pro-
cedures with the LP-PBSC-Lym program. This fact might
due to the lower PLT counts before leukapheresis in
patients undergoing leukapheresis with the LP-MNC pro-
cedure (Table 3).

The CD34-CE of 58.3 percent achieved by the LP-
PBSC-Lym program in the present study is comparable to
CD34-CE rates obtained by other cell separators: 51 per-
cent (COBE Spectra V4.7), 58 percent (COBE Spectra
V6.0), and 64 percent (Amicus, Baxter).22,24,25 The CD34-
CEs reported for two other cell separators (MCS3P, Ha-
emonetics, Munich, Germany [43%]; and CS3000, Baxter
[48%]) are somewhat lower.22,25 The median CD34-CE of
77.5 percent with the LP-MNC program on the COM.TEC;
is very promising. Rowley et al.\textsuperscript{24} demonstrated a CD34-CE of about 80 percent with the V4.7 program on the COBE Spectra. However, the V4.7 program works semi-automatically and requires continuous operator control during leukapheresis. In contrast, both LPs for use on the COM.TEC run automatically once the spillover volume has been adjusted during the first two to four separation cycles. Ravagnani et al.\textsuperscript{23} reported on median CD34-CEs ranging between 68 and 83 percent with the automatic program V6.0 of the COBE Spectra, but the maximum CD34-CE rates ranged up to 189 percent, a fact that may have contributed to the very promising results. In contrast, other investigators achieved CD34-CEs from 43 percent to 58 percent with the V6.0.\textsuperscript{24,32,40} The variability of CD34-CE rates of the COBE Spectra V6.0 may be related to individual modifications of the software default by the different authors.

Based on the findings of the present study obtained by the COM.TEC cell separator, we conclude that the LP-MNC program should preferably be used for PBPC harvesting when a high CD34-CE is the goal of leukapheresis and that the LP-PBSC-Lym program should be used when the collection of leukapheresis concentrates with a high MNC purity is required. Certainly, further studies must be performed, however, to allow for a final evaluation of this new cell separator.

REFERENCES


