Quality of Red Blood Cells Using the Dideco Electa™ Autotransfusion Device

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Abstract: The purpose of this study was to evaluate the quality of washed, concentrated red blood cells (RBCs) produced by the new Electa autotransfusion device from Cobe Cardiovascular (Dideco). Blood was collected intraoperatively in 16 patients undergoing cardiac surgery for whom routine cell salvage was being used and then washed using the Electa. According to the manufacture’s protocol, 125-mL bowls were used in the standard wash program. Reservoir and washed RBCs were analyzed for platelets (PLTs), leukocytes (WBCs), potassium (K⁺), and plasma-free hemoglobin (PFH) removal, as well as, hematocrit (Hct) and RBC recovery. The Electa cell saver produced a product with an average Hct of 58 ± 5% and a RBC recovery rate of 87 ± 10%. Its removal of waste products resulted in the washout of 54 ± 18% WBCs, 87 ± 6% PLTs, 91 ± 4% K⁺, and 77 ± 17% PFH. The Electa produces a good-quality washed RBC product that is comparable with other autotransfusion devices on the market. Keywords: Electa™, quality, washed, autotransfusion device, red blood cells.

The first commercially available red blood cell (RBC)-salvaging device was manufactured by the Haemonetics Corporation in 1974 (1). Since then, many other companies have entered this market. Dideco, one of these companies, introduced their first cell saver in 1978 (2). From that time, many versions of the original model have been developed. Dideco’s latest version (2003) is the Electa™ Autotransfusion cell separator. This study examines Electa’s ability to concentrated RBCs and how efficiently these cells were washed.

MATERIALS AND METHODS

All patients undergoing cardiac surgery had a 150-μm cell saver cardiotomy reservoir set up at the beginning of the procedure. Shed mediastinal blood was suctioned and sequestered in the reservoir. If sufficient blood volume (>400 mL) was collected, then it was processed using the Electa cell separator.

The Electa was set up following the manufacturer’s protocol. It was operated using the automatic mode and the fill, wash, and empty rates were strictly followed to maintain consistency between samples.

Sampling was accomplished using two quarter-inch luer connectors with stopcocks. These connectors were cut into the cell saver circuit just distal to the cardiotomy reservoir outlet and immediately proximal to the blood collection bag. Before the initiation of the fill cycle, the cardiotomy reservoir was agitated to improve mixing. Blood samples were drawn using needless syringes to reduce hemolysis and, once collected, sent to the laboratory for analysis.

The samples were analyzed to determine hematocrit (Hct), RBC recovery, and the elimination of undesirable blood components. The RBC recovery was determined by comparing the number of RBCs in the cardiotomy reservoir to that in the collection bag.

A comparison of the concentration differences of white blood cells (WBCs), platelets (PLTs), K⁺, and plasma-free hemoglobin (PFH) in the reservoir and collection bag determined how well the Electa removed these components and thus the quality of its wash.

Electa Operating Parameters

According to the manufacture’s protocol, we used a 125-mL Latham bowl operated with a centrifuge speed of 5600 rpm. The bowl filled at a speed of 300 mL/min and washed at rate of 250 mL/min, with a wash volume of 900ml.

RESULTS

The Electa cell saver was used to process the suctioned...
shed blood from 16 patients undergoing cardiac surgery. For comparison, Table 1 shows the before and after results of all the measured components.

RBC Recovery
The Electa product had an average Hct of 58% ± 5%. This corresponded to an 87% ± 10% RBC recovery. This was calculated using the following formula:

\[
\text{RBC Recovery} \times 100 = \frac{(V_{HB} \times Hct_{HB})}{(V_R \times Hct_R)}
\]

where \( V_{HB} \) = holding bag volume (mL), \( Hct_{HB} \) = holding bag hematocrit (%), \( V_R \) = reservoir volume (mL), and \( Hct_R \) = reservoir hematocrit (%).

Wash Quality
The other aspect of a cell savers performance is how well it removes the undesirable components. The elimination of these components as a percentage removal is shown in Table 2. These results were calculated using the following formula.

\[
\% \text{ Removal} = \left[ 1 - \frac{(V_{HB} \times [\text{Sub}]_{HB})}{(V_R \times [\text{Sub}]_R)} \right] \times 100
\]

where \( V_{HB} \) = volume in the holding bag (mL); \( [\text{Sub}]_{HB} \) = concentration of substance in the holding bag; \( V_R \) = processed volume in the reservoir (mL); and \( [\text{Sub}]_R \) = concentration of substance in the reservoir.

DISCUSSION
Our group found that the Electa cell saver was as easy to operate in relation to the other cell savers that we have evaluated in the past. In this study, we reported both HCT and RBC cell recovery. One of the main goals of a cell saver should be, as the name implies, to salvage as many RBCs as possible. This can be determined by examining the total RBCs in the collecting reservoir and comparing it with the total number of RBCs in the collection bag. We have found from experience that even if a cell saver has a high Hct product, it does not necessarily have a high red blood cell recovery (3). The Electa had both a high Hct and a high RBC recovery rate.

A literature review revealed several studies using the Electa as a cell saver device. Cuby et al. (4) looked at 23 consecutive patients undergoing total hip and knee arthroplasties for which the Electa was the cell saver used to process the blood loss. Cuby’s results showed a post Hct of 60.8 ± 0.80%. The elimination of PLT, WBC, and PFH was 93.6 ± 5.1%, 81.50 ± 13.8%, and 95.1 ± 2.6%. The results are similar for the Hct but differ from others in the elimination of undesirable products. They reported a better washout than we experienced, however the wash volume they used was not stated and could account for this difference.

A previous study by Serrick et al. (3) at our institution compared 5 different cell savers under the same conditions as this study. We evaluated the Medtronic Autolog, Cobe Baylor Rapid Autotransfusion Device (BRAT), Medtronic Sequestra 1000, Fresenius CATS, and the Haemonetics Cell Saver 5. When compared with these cell savers, the Electa showed no difference in potassium removal. PLTs, PFH, and WBCs were best removed by the Autolog (PLTs: 99 ± 1%, PFH: 92 ± 4%, and WBCs: 78 ± 11%; \( P < 0.05 \)) (4). When we compared the RBC recovery, the Electa had a better results than the Sequestra and Autolog. Electa had a recovery rate of 87%, the Sequestra 76%, and the Autolog 79%. However, no cell saver was superior to the rest in all categories. In conclusion, the Electa cell separator performed adequately in comparison with our previous evaluation of other cell savers.

REFERENCES

Table 1. Results before and after of all measured components.

<table>
<thead>
<tr>
<th></th>
<th>Hct (%)</th>
<th>K (mmol/L)</th>
<th>PLT (×10^9/L)</th>
<th>PFH (mg/L)</th>
<th>WBC (×10^9/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>14.7 ± 6</td>
<td>4.3 ± 3.4</td>
<td>72 ± 37</td>
<td>3428 ± 1020</td>
<td>3.8 ± 0.10</td>
</tr>
<tr>
<td>After</td>
<td>58 ± 5</td>
<td>1.8 ± 0.6</td>
<td>40 ± 22</td>
<td>5444 ± 9913</td>
<td>8.6 ± 2.3</td>
</tr>
</tbody>
</table>

Table 2. Elimination of componets via cell saver, %.

<table>
<thead>
<tr>
<th></th>
<th>K^+</th>
<th>PLT</th>
<th>PFH</th>
<th>WBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>91% ± 4%</td>
<td>87% ± 6%</td>
<td>77% ± 17%</td>
<td>54% ± 18%</td>
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