Title: CHANGES IN SERIAL PLATELET COUNTS FOLLOWING MASSIVE BLOOD TRANSFUSION IN PEDIATRIC PATIENTS

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INTRODUCTION

Massive transfusion, defined as transfusion of ≥ 1 blood volume (BV), commonly occurs in young children undergoing major corrective surgery or burn wound debridement. No adequate data exist for children examining the serial changes in platelet counts during massive blood loss. Such information is essential to predict the need for and timing of platelet replacement. To clarify the problem of dilutional thrombocytopenia in children, we undertook the present prospective study, with approval of the Human Studies Committee.

METHODS

Twenty-three pediatric patients age 1-17 years undergoing major surgical procedures were examined. Estimated blood volume (EBV) was assumed to be 75 ml/kg for burned patients and children under 1 yr. For all others, EBV was calculated at 70 ml/kg. In addition to routine monitoring, urine output was observed in all patients; directly transduced arterial (n=23) and central venous catheters (n=21) were also utilized. Patients were anesthetized with halothane-N2O-O2 or N2O-O2-muscle relaxant-narcotic technique. Controlled ventilation maintained PaCO2 at 35-45 torr. Baseline samples for platelet count, prothrombin time (PT), and partial thromboplastin time (PTT) were taken prior to the surgical incision; baseline central venous (CVP) and arterial pressures were noted. Efforts were made to maintain a constant CVP. One BV was considered lost when a volume equal to the EBV had been transfused. Blood was replaced with frozen packed cells, 5% albumin, fresh frozen plasma, and lactated Ringer's as indicated to maintain normal cardiovascular parameters. All data are expressed as mean ± S.E.

RESULTS

The age of patients studied was 5.6 ± 1.2 yrs; weight, 23.9 ± 3.9 kg. All patients lost at least 1 BV; ten lost 2 BV; three lost 3 BV; two lost 4 BV; and one lost 5 BV. Fifteen had burn wound excision; six, sciaticus repair; one, tumor excision; one, Whipple procedure. The time (hrs) for loss of the first BV was 2.3 ± 0.3; the second BV, 1.3 ± 0.2; the third BV, 0.9 ± 0.1. Serial platelet counts are presented in Table 1. Figure 1 presents the reduction in platelet counts as a per cent of baseline ± S.E. After one BV replacement the platelet count was reduced 42% ± 2.5% (range 19-62%); 2 BV, 64.6% ± 2.5% (51-71%); 3 BV, 70% ± 3.2% (65-76%). Clinical bleeding occurred in 3 patients and all had a normal PT and PTT; two had platelet counts below 50,000/mm³ and responded to platelet transfusion. The third had a count of 9000. This last patient had abdominal compression (slipped off support during Harrington rod insertion), and increased venous pressure probably accounted for the abnormal bleeding observed. Three other patients whose platelet counts fell to < 100,000 received a platelet transfusion before clinical bleeding was evident. In these patients considerably more blood loss was anticipated. One patient lost 5 BV and did not require platelets (final count 156,000).

DISCUSSION

Studies in adults have always correlated serial platelet counts with units of blood transfused. The study correlates platelet counts with blood volumes transfused, an important concept for all patients, but particularly for children. The per cent fall in platelet count parallels similar studies of adult patients. Likewise, clinical bleeding occurred when counts fell below 50,000 despite normal PT and PTT values and stopped after platelet transfusion. Knowledge of the initial platelet count related to predicted or measured blood loss makes it possible to estimate the point at which exogenous platelets will be needed. If a child has a high initial platelet count, he may not need exogenous platelets despite massive losses. Some patients in this series who lost 3 to 5 BV did not bleed abnormally. Anticipation of platelet needs allows for more efficient interaction with the Blood Bank. If abnormal bleeding occurs despite a platelet count above 50,000, other causes such as increased venous pressure, disseminated coagulopathy, or thrombocytopenia must be considered.

Table 1: Platelet count in 1000/mm³ ± S.E.M. versus blood volumes transfused.

<table>
<thead>
<tr>
<th>Number of Patients</th>
<th>Baseline</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelets</td>
<td>379 ± 40</td>
<td>213 ± 23</td>
<td>122 ± 25</td>
<td>124 ± 48</td>
<td>124 ± 24</td>
</tr>
</tbody>
</table>

Figure 1

CHANGE IN PLATELET COUNT PERCENT OF BASELINE

BLOOD VOLUMES LOST

N=23
N=10
N=3
N=2