### Table 9-1. Platelet Thresholds for Therapeutic Transfusion During Active Bleeding

<table>
<thead>
<tr>
<th>Clinical Indication</th>
<th>Treatment Trigger ($\times 10^9$ platelets/L)</th>
<th>Level of Evidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major bleeding and thrombocytopenia or massive hemorrhage</td>
<td>50 to 75</td>
<td>Grade C, level IV</td>
</tr>
<tr>
<td>Massive transfusion and multiple trauma or TBI</td>
<td>75 to 100</td>
<td>Grade C, level IV</td>
</tr>
<tr>
<td>Surgery</td>
<td>50 to 100</td>
<td>Grade B, level III to Grade C, level IV</td>
</tr>
<tr>
<td>DIC</td>
<td>50</td>
<td>Grade C, level IV</td>
</tr>
<tr>
<td>DIC in neonates</td>
<td>100</td>
<td>Grade C, level IV</td>
</tr>
<tr>
<td>Intracerebral bleeding</td>
<td>100</td>
<td>Grade C, level IV</td>
</tr>
<tr>
<td>Platelet function defects</td>
<td>No threshold</td>
<td>Grade C, level IV</td>
</tr>
</tbody>
</table>


**Statements of Evidence**  
Ia: Evidence obtained from meta-analysis of randomized controlled trials.  
Ib: Evidence obtained from at least one randomized controlled trial.  
IIa: Evidence obtained from at least one well-designed controlled study without randomization.  
IIb: Evidence obtained from at least one other type of well-designed quasi-experimental study.  
III: Evidence obtained from well-designed nonexperimental descriptive studies, such as comparative studies, correlation studies, and case studies.  
IV: Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.  

**Grades of Recommendations**  
A: Requires at least one randomized controlled trial as part of a body of literature of overall good quality and consistency addressing the specific recommendation. (Evidence levels Ia, Ib.)  
B: Requires the availability of well-conducted clinical studies but no randomized clinical trials on the topic of recommendation. (Evidence levels IIa, IIb, III.)  
C: Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates an absence of directly applicable clinical studies of good quality. (Evidence level IV.)  

TBI = traumatic brain injury; DIC = disseminated intravascular coagulation.
Transfusions During Active Bleeding

**Clinical Assessment of Bleeding**

“Clinically significant bleeding” usually means bleeding that is more significant than skin bleeding or epistaxis and that lasts for more than 30 minutes. This type of bleeding has been classified in platelet transfusion trials in hematology patients as World Health Organization (WHO) Grade 2 or above. Many platelet transfusion trials now use bleeding as a primary outcome; however, previous studies have shown a wide variation in the amount (5% to 70%) and type of bleeding. The assessment of bleeding involves an element of subjectivity, and the literature indicates wide variability in the methods by which bleeding has been assessed and documented in clinical trials of platelet transfusion. Taken together, these factors may be responsible, in part, for differences in reported baseline bleeding rates. In cardiac surgery, classification of bleeding events are based on criteria developed by the Thrombolysis In Myocardial Infarction (TIMI) and Global Use of Strategies to Open Coronary Arteries (GUSTO) groups. However, these grading systems consider hemorrhage requiring blood transfusion as only moderate. As a result of advances in interventional cardiology, the number of patients requiring transfusion has decreased significantly, and assessment of more minor bleeding may be required.

**Major Hemorrhage**

Traditionally, major hemorrhage has been defined as the loss of one blood volume within a 24-hour period. Alternative definitions include a loss of 50% blood volume within 3 hours, or a rate of blood loss of 150 mL/minute. Clinical evidence of major blood loss is apparent when a patient presents with profound shock from bleeding [eg, a systolic blood pressure (SBP) <70 mm Hg or a SBP <90 mm Hg after an initial fluid challenge]. These physiologic parameters can be recognized readily in clinical practice, an important consideration when the early identification of severe hemorrhage is critical for improving the chances of a successful outcome.

Strategies to manage major bleeding have undergone significant changes over the last decade, driven by the poor outcomes seen following the use of traditional treatment algorithms, the recognition of the important role that coagulopathy plays in exacerbating severe bleeding, and the evidence that has emerged from observational studies in the military and civilian trauma settings (see below).
Coagulopathy Associated With Major Hemorrhage

Coagulopathy is an important risk factor for severe, life-threatening hemorrhage. For example, 25% to 30% of all trauma patients are known to have a coagulopathy by hospital admission, and this has been shown to be associated with a three- to fourfold increased risk of death. Coagulopathy is a common consequence in all situations of major blood loss, not just trauma, and transfusion practices now target this coagulopathy as a treatment priority in an attempt to secure hemostasis. There are several causes of worsening hemostasis during major blood loss, and these include the following:

1. **Consumption.** Coagulation factors and platelets are consumed during the formation of fibrin clots.

2. **Dilution.** This is a consequence of the replacement of the whole blood that is lost with crystalloid, colloid, and red cell transfusions. The replacement of two blood volumes with red cell concentrates alone results in a platelet count on the order of $50 \times 10^9/L$.

3. **Hypoxia, acidosis, and hypothermia.** This triad predisposes to further bleeding. Hypothermia and acidosis impair the functional ability of both the platelets and the coagulation proteases. Hemostatic defects are most evident once pH values fall below 7.1, and temperatures below 33 C, although significant platelet dysfunction is seen between 33 and 37 C.

4. **Ongoing bleeding.** Anemia has an effect on primary hemostasis. A low hematocrit reduces axial flow (where all the red cells flow in the middle of an arteriole, and platelets and plasma are pushed into close proximity to the endothelium) and thus reduces the margination of platelets and platelet-endothelial interaction.

Laboratory Methods to Diagnose or Monitor the Actively Bleeding Patient

Most laboratories use a panel of screening tests to determine whether an actively bleeding patient has an underlying coagulation or inherited/acquired platelet defect, including von Willebrand disease (vWD). If the screening tests are all normal but the clinical suspicion is strong for a hemostatic defect, it is imperative that a complete laboratory workup be performed. However, this should not delay management in an emergency.