CME Topic

Thrombocytopenia in Adults: A Practical Approach to Evaluation and Management

Sudhir S. Sekhon, MD and Vivek Roy, MD, FACP

Abstract: With the widespread use of automated cell counters, clinicians in any field of medicine may encounter thrombocytopenia. The symptomatology may vary greatly and the underlying cause may be either inconsequential (pseudothrombocytopenia) or life threatening. It is important to be aware of common conditions leading to thrombocytopenia and have a systematic approach to evaluation and management of these patients. In this review we highlight common etiologies seen in adult patients with thrombocytopenia. A brief description and management approach to common conditions, as well as to conditions that may be less frequent but require emergent intervention, is provided. Often the clinician is called upon to make a decision about platelet transfusions. The review also discusses the various types of platelet products available for transfusion and gives guidance regarding selection of the appropriate product, indications and contraindications, and suggested target platelet counts for various clinical situations.

Key Words: thrombocytopenia, platelets, primary care, platelet transfusion

Platelets are formed by fragmentation of megakaryocytes. They circulate in the blood for 7 to 10 days and play a critical role in hemostasis. Significant quantitative or qualitative platelet dysfunction results in mucocutaneous bleeding. Under normal circumstances, about a third of the total number of platelets are found in the spleen.

With the widespread use of automated cell counters, it is not unusual to unexpectedly find patients with low platelet counts. About 0.9% of patients in the acute care setting and 25 to 41% of patients in the ICU setting were thrombocytopenic in one study.[1,2] Thus, thrombocytopenia may confront any clinician who orders a complete blood count for any reason. This review is directed at the nonhematologist who is often the first person to notice this condition and needs to differentiate the life threatening causes from the less critical ones. We suggest an approach for stepwise evaluation and initial treatment of thrombocytopenia. In addition, brief clinical descriptions of the common etiologies are also provided.

Definition

Thrombocytopenia is defined as a platelet count below the normal range for the population (± 2 standard deviations). In most laboratories, a normal platelet count is between 150,000 to 450,000/μL. By definition, 5% of the population will have counts outside the "normal" range. No generally accepted definition of mild, moderate or severe thrombocytopenia exists. For cancer patients receiving treatment, the National Cancer Institute (NCI) has developed the Common Toxicity Criteria to describe severity of thrombocytopenia. Platelet counts of 75,000 to 150,000/μL are defined as grade 1 thrombocytopenia, 50,000 to <75,000/μL as grade 2, 25,000 to <50,000/μL as grade 3, and below 25,000/μL as grade 4 thrombocytopenia. (CTCAE v3.0; www.ctep.cancer.gov/reporting/ctc.html)

As in many biologic systems, there is significant redundancy in the body's hemostatic system. Bleeding time is generally not prolonged until the platelet count is below 100,000/μL. However, as long as platelet counts are above 20,000/μL,

Key Points

- Thrombocytopenia may confront any physician who orders blood counts, in any field of medicine.
- An evaluation algorithm and a listing of common causes will help clinicians diagnose thrombocytopenia and be able to triage life-threatening from less serious causes.
- In vitro platelet clumping (pseudothrombocytopenia) is common and must be differentiated from true thrombocytopenia.
- Physicians should be alert to the possibility of heparin-induced thrombocytopenia, as a delay in diagnosis can result in serious morbidity or mortality.
- A summary of indications and suggested thresholds for platelet transfusions in various clinical situations is included.

From the Department of Hematology and Oncology, Mayo Clinic, Jacksonville FL.

Reprint requests to Vivek Roy, MD, FACP, Hematology-Oncology Department, Mayo Clinic, Jacksonville, FL 32224. Email: roy.vivek@mayo.edu

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clinical manifestations are mild; often limited to easy bruising. Below 10,000/μL, the risk of spontaneous mucocutaneous bleeding (gingival bleed, epistaxis, menorrhagia, petechiae and ecchymoses) and life threatening, spontaneous intracranial hemorrhage or gastrointestinal bleeding increases rapidly. It is important to remember that the platelet count is an imprecise predictor of risk, and several factors such as functional defects modify the bleeding risk.

Diagnostic Approach

When faced with an asymptomatic patient with a low platelet count, the clinician should initially seek to exclude artifactual or "pseudothrombocytopenia" as the etiology. This is caused by in vitro clumping of platelets when ethylenediaminetetraacetic acid (EDTA) is used as an anticoagulant (see below). The presence of platelet clumps on examination of the peripheral blood smear and normal repeat platelet count using citrated blood confirms pseudothrombocytopenia as the cause.

If thrombocytopenia is confirmed, a stepwise evaluation should be undertaken to assess the causes and the urgency of treatment. If diagnoses such as thrombotic thrombocytopenic purpura (TTP) or heparin-induced thrombocytopenia (HIT) are suspected, immediate intervention is required. In addition, any patient with severe thrombocytopenia or evidence of hemorrhage should receive immediate attention and possible platelet transfusion.

A detailed comprehensive history can provide valuable diagnostic information. The history should focus on identifying the presence of bleeding with particular attention to critical sites including the head and gastrointestinal tract, as patients with TTP can present with intermittent confusion. A recent viral respiratory illness can sometimes be associated with transient thrombocytopenia. A complete medication history including use of over-the-counter (OTC) products should be elicited. A history of prior low platelet counts or bleeding tendency should be sought and previous blood counts reviewed. Family history of platelet disorders should be elicited. Occasionally, congenital thrombocytopenia will be first diagnosed in an adult. History pertaining to alcohol consumption and HIV risk factors should be obtained.

Physical examination should focus on finding the presence of bleeding in the skin, mucous membranes, gastrointestinal tract, brain, urinary tract, and retroperitoneum. The presence of retinal hemorrhage on ocular fundus examination is a predictor of CNS hemorrhage. Typically, patients with thrombocytopenia do not have soft tissue or joint bleeding. Their presence should raise suspicion of additional coagulation problems. Presence of vascular thrombi raises the possibility of HIT or disseminated intravascular coagulation (DIC). A diligent neurologic examination should indicate the need for imaging in patients with a suspected IC bleed. Patients with TTP can present with mental status changes. The presence of lymphadenopathy and splenomegaly can also provide clues to the diagnosis.

Initial laboratory evaluation should include a peripheral blood smear, serum creatinine, DIC panel, LDH, total and direct bilirubin, AST and ALT. This allows an initial determination of whether thrombocytopenia is an isolated abnormality or part of a constellation of abnormalities that may suggest a specific diagnosis. If hemolysis is suspected then a direct antiglobulin test (Coombs test), reticulocyte count and haptoglobin should be checked. The presence of schistocytes on the smear is suggestive of TTP or DIC. Differentiation is usually made by the presence of normal coagulation parameters in TTP and elevated PT, PTT, fibrin split products, and low fibrinogen in DIC. An HIV test is indicated in patients with any risk factors. Vitamin B_{12} and folate levels can help diagnose nutritional causes of thrombocytopenia. Suspicion of connective tissue disorders should lead to appropriate serologic testing. In considering potential causes of thrombocytopenia, it may be helpful to take a pathophysiology-based approach as suggested in Table 1, keeping in mind that distinct pathogenetic mechanisms are not mutually exclusive. A clinical approach based on common diagnostic considerations under different clinical scenarios is outlined in Table 2.

Role of Bone Marrow Exam

A bone marrow biopsy may help differentiate inadequate production versus excessive destruction/consumption as the predominant cause of thrombocytopenia. In general, a bone

Table 1. Pathophysiologic classification of thrombocytopenia

Decreased Production	Increased Destruction
• Hematologic malignancies	Immune
• Aplastic anemia	• ITP
• Myelodysplasia	• HIT
• Drugs: chemotherapy, alcohol	• Drug-induced antibodies
• Radiation	• HIV
• HIV	• Post transfusion purpura
• Vitamin D deficiencies	• Connective tissue diseases
• Hereditary thrombocytopenias	Nonimmune
• Metastatic cancer to bone marrow	• DIC
	• Sepsis
	• Cardiac valves
	• TTP-HUS
	• Kasabach Merrit syndrome
	Splenic Sequestration
	• Hypersplenism

HIV, human immunodeficiency virus; ITP, idiopathic thrombocytopenic purpura; HIT, heparin-induced thrombocytopenia; DIC, disseminated intravascular coagulation; TTP-HUS, thrombotic thrombocytopenic purpura-hemolytic uremic syndrome.

Table 2. Selected differential diagnoses according to the clinical scenario

Thrombocytopenia in. . .				
Ambulatory patient	Acutely ill patient	Pregnant patient	Cardiac patient	Patient with thrombosis
• ITP	• DIC	• Gestational	• HIT	• HIT
• Drug-induced	• Infection/sepsis	• ITP	• Cardiac bypass	• Antiphospholipid antibody syndrome
◦ Chemotherapy	• Drug-induced	• HELLP	• GPIIb/IIIa inhibitor related	• Paroxysmal nocturnal hemoglobinuria
◦ Misc Drugs	◦ HIT		• TTP-related to clopidogrel or ticlopidine	
• Infections	◦ Miscellaneous		• Dilutional	
◦ EBV	◦ Drugs			
◦ HIV	• TTP-HUS			
◦ Others	• Post transfusion purpura			
• Connective tissue disorders				
◦ SLE				
◦ Rheumatoid arthritis				
◦ Antiphospholipid antibody syndrome				
• Hypersplenism				
• Primary marrow disorder				

HIV, human immunodeficiency virus; ITP, idiopathic thrombocytopenic purpura; HIT, heparin-induced thrombocytopenia; DIC, disseminated intravascular coagulation; TTP-HUS, thrombotic thrombocytopenic purpura-hemolytic uremic syndrome; EBV, Epstein-Barr virus; SLE, systemic lupus erythematosus; HELLP, hemolysis, elevated liver function, and low platelets.

marrow biopsy is indicated when a platelet production problem is suspected to help delineate the cause of underproduction. If peripheral destruction/sequestration is suspected, such as in immune thrombocytopenic purpura (ITP), DIC, or TTP, a bone marrow biopsy is unlikely to provide useful additional information. However, in elderly patients, patients with simultaneous abnormalities in red and/or white cells, and in patients without a definitive cause after initial workup, a bone marrow examination can elucidate the presence of a primary marrow disorder, such as myelodysplasia, leukemia or lymphoma. The incidence of these conditions generally rises with age.

A suggested algorithm for evaluation of thrombocytopenia is presented in the Figure.

Common Etiologies

Pseudothrombocytopenia

This is a laboratory artifact caused by platelet clumping due to naturally occurring antibodies directed against normally hidden epitopes of platelet surface antigens. EDTA, the anticoagulant in purple top Vacutainer® tubes, causes calcium chelation and induces conformational change exposing the target epitopes of platelet antigens.[3] Pseudothrombocytopenia is seen in approximately 1 in 1,000 individuals and has no clinical significance. It is evident on a peripheral smear by the presence of platelet clumps. If pseudothrombocytopenia is suspected, repeat testing using citrated blood (blue top tube) will yield the true platelet count. It is essential to rule out this condition before embarking on further evaluation of any patient with thrombocytopenia. In one study, 15.3% of ambulatory patients with isolated thrombocytopenia had pseudothrombocytopenia.[4]

Immune Thrombocytopenic Purpura (ITP)

Immune thrombocytopenia is a relatively common disease in adults. A Danish study noted an incidence rate of 2.68 per 100,000.[5] ITP is an autoimmune condition caused by antiplatelet antibodies, which result in decreased platelet survival. These antibodies are frequently IgG in nature and directed against platelet antigens GP IIb/IIIa and GP Ib/IX complexes. The spleen is the major site of platelet destruction. While all ages may be affected, frequently patients are young adult females. Severe thrombocytopenia typically presents without anemia or leukopenia. Autoimmune hemolytic anemia is sometimes seen in association with ITP and this is referred to as Evans syndrome. Usually a bone marrow examination is not necessary unless atypical features are present and an alternative diagnosis is suspected. The antiplatelet antibody test lacks sensitivity and specificity and is generally not helpful clinically.

In adults, ITP is typically a chronic disease which can remit and relapse over time. Many patients do not require treatment and the decision to initiate treatment is individualized, depending on platelet counts, the presence of hemorrhage, and the lifestyle-related bleeding risk of the patient.[6] Initial management is undertaken with corticosteroids. A commonly used regimen utilizes prednisone 1 mg/kg/d for 1 to 2 weeks, followed by a gradual taper. Recently, short "pulses" of dexamethasone have been found to be very effective.[7] IV

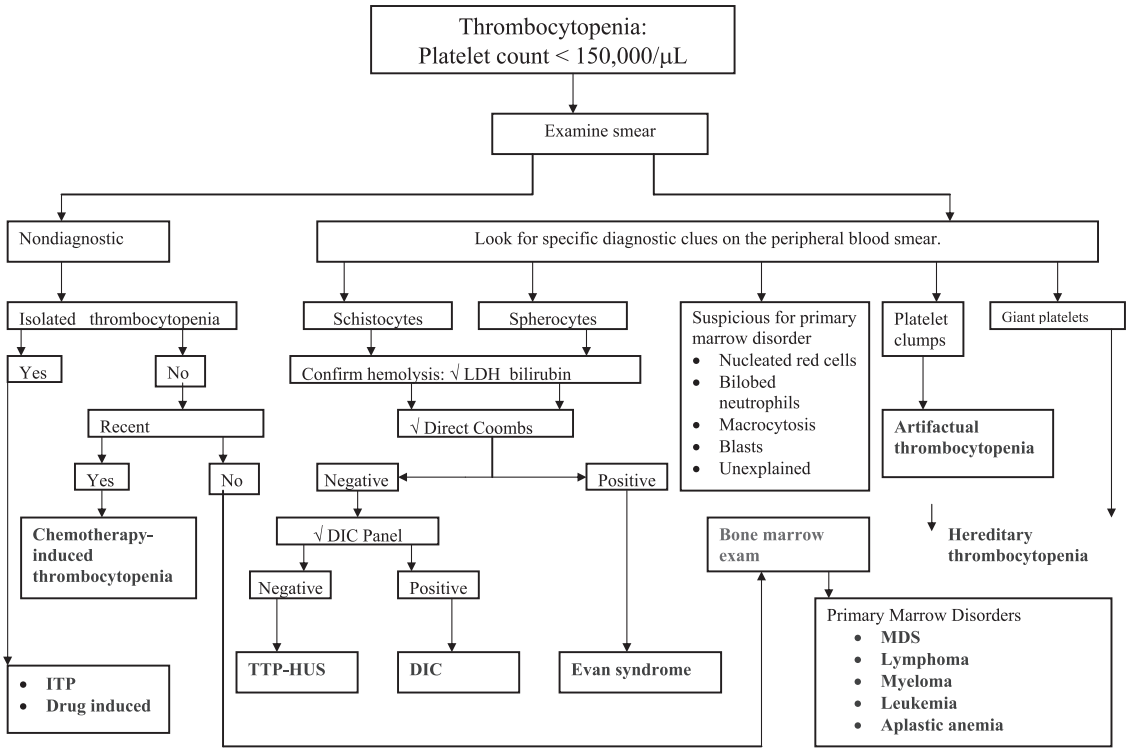

Fig. Algorithm for workup of thrombocytopenia

immunoglobulin (IVIG) infusion (1gm/kg/d for 2 d) or anti-RhD antibodies (WinRho) can be used when rapid platelet increment is desirable.[8,9] Anti-RhD antibodies are effective only in patients who are RhD-positive and have an intact spleen. Persistent or recurrent severe thrombocytopenia of 4 to 6 weeks' duration is usually considered an indication for splenectomy. Other treatment options include danazol, cyclophosphamide, azathioprine, rituximab or autologous transplantation.[6,10]

Thrombotic Thrombocytopenic Purpura—Hemolytic Uremic Syndrome (TTP-HUS)

TTP-HUS is a relatively uncommon, life-threatening cause of thrombocytopenia. The classic diagnostic pentad of TTP includes 1) microangiopathic hemolytic anemia, 2) thrombocytopenia, 3) renal insufficiency, 4) fever, and 5) mental status changes.[11] However, the pentad is seen in less than 40% of cases.[12] Neurologic symptoms can range from confusion, headaches and fatigue to seizures and stroke-like syndrome. These can wax and wane over time. The presence of thrombocytopenia and schistocytes (red cell fragments) at 1 per high power field on smear is commonly seen. Thrombocytopenia can be severe with median platelet counts of 20,000/μL. The LDH can be elevated and renal insufficiency is common. Coagulation parameters are usually normal and help differentiate this condition from DIC, which is a common differential diagnosis. Coombs test is negative and helps differentiate this condition from Evans syndrome. However, the appearance of the entire pentad is a late finding and is associated with very poor outcome. Early diagnosis is of paramount importance for optimal outcome. A diagnosis of TTP-HUS should be considered in any patient with thrombocytopenia and evidence of microangiopathy.[13,14] TTP can be idiopathic or secondary, associated with *Escherichia coli* O157:H7 diarrhea, HIV infection, certain drugs (ticlopidine, clopidogrel, quinine, cyclosporine A, mitomycin A, cisplatin, etc), pregnancy, bone marrow transplant and metastatic carcinomas.[15]

The pathogenesis of idiopathic TTP has been elucidated over the last few years. An inherited or acquired deficiency (due to autoantibodies) of von Willebrand factor-cleaving protease known as ADAMTS13 leads to accumulation of large multimers of von Willebrand factor which cause spontaneous platelet aggregation and thrombi.[16] A clinical assay for ADAMTS13 has been introduced into clinical practice but because the results are usually not immediately available, the diagnosis of TTP and the decision to initiate treatment remains clinical.

Emergent plasma exchange is the cornerstone of TTP treatment.[13,17] If this is not immediately available, infusion of fresh frozen plasma can be initiated before plasma exchange. Corticosteroids, dipyridamole, and aspirin have been used but

are of uncertain value.[17] Platelet transfusions can theoretically worsen the clinical situation and should be avoided unless life-threatening hemorrhage occurs.

Drug-induced Thrombocytopenia

Drugs are a common cause of thrombocytopenia.[18] Drugs commonly associated with thrombocytopenia are listed in Table 3. However, this list is not comprehensive and practically any drug can cause thrombocytopenia. When evaluating a patient with thrombocytopenia, a medication history (including over-the-counter medications) should be carefully elicited and any recently initiated drug should be suspected. Cytotoxic chemotherapy and ethanol cause thrombocytopenia by directly inhibiting megakaryocytes. Most other drugs cause thrombocytopenia by immune mechanisms.

Heparin is the most common cause of drug-induced thrombocytopenia and is discussed in further detail below. GPIIb/IIIa inhibitors are associated with severe thrombocytopenia in approximately 0.5 to 2% of cases.[19] Unlike other drug-induced thrombocytopenias, GPIIb/IIIa inhibitor-induced thrombocytopenia develops within 24 hours of exposure. This may be related to the presence of preformed "naturally occurring" antibodies against neoepitopes exposed by alteration of the GPIIb/IIIa molecule.[20] Treatment of drug-induced thrombocytopenia is discontinuation of the offending drug and supportive care. Recovery of platelet counts can be expected in 5 to 7 days. Platelet transfusions may be needed in severely thrombocytopenic and/or bleeding patients.

Chemotherapy-induced Thrombocytopenia

With the increasing prevalence of cancer, chemotherapy has become a common cause of thrombocytopenia. The history is usually readily available and patients often have cytopenia in other cell lines also. With most chemotherapy agents, nadir blood count occurs 7 to 10 days after chemotherapy and recovery over 2 to 3 weeks. Some agents like nitrosoureas and mitomycin can cause more prolonged myelosuppression. Platelet transfusions are occasionally needed and dose adjustment of future chemotherapy doses may be necessary. It is important to recognize that certain agents like mitomycin can also cause TTP.

Heparin-induced Thrombocytopenia (HIT)

HIT is a common cause of drug-induced thrombocytopenia in hospitalized patients. Two types of HIT have been described. Type 1 HIT is a modest transient decrease in platelet counts that occurs within the first 2 to 3 days after heparin initiation and returns to normal spontaneously, even with continuation of heparin. It is generally of no clinical significance. Type 2 HIT (also called heparin-induced thrombocytopenia and thrombosis [HITT], and white clot syndrome) is less common, seen in about 0.3 to 5% of patients treated with

Table 3. Drugs commonly associated with thrombocytopenia

Abciximab
Amiodarone
Amphotericin B
Carbamazepine
Cimetidine
Digoxin
Eptifibatide
Fluconazole
Furosemide
Heparin
Interferon Alpha
Phenytoin
Piperacillin
Quinidine
Quinine
Ranitidine
Trimethoprim/Sulfamethoxazole
Valproic Acid
Vancomycin
Acetaminophen
Aminoglutethimide
Aminosalicylic Acid
Ampicillin
Amrinone
Captopril
Chlorothiazide
Chlorpromazine
Chlorpropamide
Danazol
Deferoxamine
Diatrizoate Meglumine
Diazepam
Diazoxide
Diclofenac
Diethylstilbestrol
Gold
Haloperidol
Hydrochlorothiazide
Ibuprofen
Isoniazid
Levamisole
Lithium
Meclofenamate
Methicillin
Methyldopa
Minoxidil
Nalidixic Acid
Naphazoline
Oxyphenbutazone
Oxytetracycline
Procainamide
Rifampin
Sulfasalazine
Sulfisoxazole
Sulindac
Tamoxifen
Thiothixene
Tirofiban

More common associations are in **bold** print.

unfractionated heparin. It is caused by antibodies against platelet factor 4-heparin complex.[21] It usually occurs 4 to 14 days after heparin initiation, but may occur earlier in patients with prior exposure to heparin. It should be suspected in any patient with falling platelet counts below the normal range, or a greater than 50% drop in the platelet count within the normal range. An ELISA assay for antiplatelet factor 4-heparin IgG antibody is available and has a sensitivity of $>$ 90%, but specificity ranges from 50 to 93%. Severe thrombocytopenia with platelet counts below 10,000/μL can occur, but patients are paradoxically hypercoagulable due to platelet activation. In fact, abnormal thrombosis, sometimes catastrophic, is the predominant manifestation of HIT and bleeding is uncommon. Treatment consists of stopping heparin and using alternate anticoagulants like argatroban, lepirudin, or bivalirudin. Fondaparinux is a heparin pentasaccharide analogue that does not bind to platelet-factor 4 and thus should not cause HIT.[22] Low molecular weight heparin is not an appropriate anticoagulant in the setting of HIT because of cross reactivity of the antibody.[23] As in TTP, platelet transfusions are relatively contraindicated in the absence of severe thrombocytopenia with life-threatening hemorrhage. Evidence-based guidelines for managing HIT have recently been published.[24,25]

Sepsis/Infection

Patients with sepsis often have varying degrees of thrombocytopenia. This is usually multifactorial in etiology; related to associated DIC, nonspecific immune destruction of platelets, excessive consumption, marrow suppression, and medications. Therapy consists of correction of the underlying cause of sepsis, identification of offending medications, and supportive care. Thrombocytopenia may also be seen in a variety of infections without sepsis syndrome.

Certain specific infections can be associated with thrombocytopenia. Cytomegalovirus and Epstein-Barr viral infections can cause transient thrombocytopenia. HIV infection is perhaps the most important infectious cause in North America.[26] Thrombocytopenia is thought to be related to direct marrow toxicity of the virus as well as immune-mediated mechanisms. Worldwide, malaria is a common cause. Ehrlichiosis, a tick bite-transmitted infection, is seen in the US, predominantly in southeastern and south central regions. In appropriate geographic locations, dengue, Hantavirus and other viral hemorrhagic fevers should be considered in the differential diagnosis. Some of these viruses are also potential bioterrorism agents.

Disseminated Intravascular Coagulation (DIC)

DIC is a systemic process caused by pathologic thrombin generation. Clinically, it is characterized by both thrombosis and bleeding. DIC is a complication of an underlying illness. Common etiologies include sepsis, burns, amniotic fluid embolism, abruptio placentae, trauma, snakebite, acute leukemias, and other malignancies, particularly adenocarcinomas.[27] Thrombocytopenia is almost universal in patients with DIC due to activation of the clotting mechanism. The diagnosis is usually easily made in sick hospitalized patients with oozing venipuncture sites, ecchymosis, falling platelet counts, poor platelet survival after platelet transfusion and elevated PT, aPTT, fibrin split products and low fibrinogen levels. It may be less obvious in an ambulatory patient with chronic compensated DIC, such as a patient with metastatic prostate or GI malignancy in whom a slower rate of consumption of coagulation factors may be balanced by enhanced synthesis. Thus, patients may have only a modest thrombocytopenia and normal PT and aPTT. The diagnosis is based on the presence of microangiopathy on peripheral blood smear and elevated fibrin degradation products (FDP) and D-dimer levels. It is important to consider TTP-HUS as a differential. Treatment is supportive and consists of treating the underlying cause and providing supportive blood product transfusions—platelets, cryoprecipitate, and/or fresh frozen plasma as needed are used to replace consumed coagulation factors. If thrombosis is the predominant manifestation of DIC, heparin may be considered for treatment.

Hypersplenism

Splenomegaly from any cause can result in sequestration of blood elements leading to cytopenia. The cardinal features of hypersplenism are (a) splenomegaly; (b) reduced levels of one or more blood elements in circulation associated with increased precursors; and (c) correction of cytopenia after splenectomy. Splenomegaly is almost always secondary to other disorders, most commonly cirrhosis with portal hypertension. Thrombocytopenia is usually of moderate severity and is rarely seen below 40,000/μL. In most cases, specific treatment of thrombocytopenia is not necessary. Platelet transfusions are not effective as transfused platelets are also sequestered in the spleen. Treatment is directed against the underlying cause of splenomegaly. Although splenectomy can correct thrombocytopenia, the benefit of that should be carefully weighed against the potential risks of splenectomy, including long-term infection risk.

Post Transfusion Purpura (PTP)

Post transfusion purpura is a rare complication of blood transfusion. Seen mostly in women, it presents as severe thrombocytopenia 5 to 10 days after red cells or platelet transfusion. This is an alloimmune complication that occurs in patients who have developed antiplatelet antibodies (most commonly against Pl^{A1} antigen) from prior transfusion or pregnancy.[28] Re-exposure to Pl^{A1} antigen later triggers immune-mediated destruction of platelets, including the patient's own (Pl^{A1} negative) platelets, resulting in profound thrombocytopenia. Platelet counts spontaneously recover in about 2

Table 4. Suggestions for platelet transfusions

Platelet counts below which transfusion should be considered:
• 10,000/μL - prophylactic transfusion
• 20,000/μL - in the presence of bleeding, fever, infection, platelet function defect, or coagulopathy
• 50,000/μL - prior to minor procedures, in actively anticoagulated patients or in the presence of active bleeding
• 75,000/μL - prior to general surgery
• 100,000/μL - prior to neurologic or ophthalmologic surgery

weeks. Treatment is with IVIG infusion, plasmapheresis, and transfusion of PI^{A1}-negative platelets.

Platelet Transfusions

Types of Platelet Products

Three types of platelet products are commonly used in clinical practice. These are

1. Random donor platelets
2. Single donor platelets
3. HLA-matched platelets.

Random donor platelets are prepared by separating platelets from a single unit of whole blood. Each unit has approximately 5.5×10^{10} platelets in about 50 mL of plasma. Platelet concentrates are stored at room temperature as refrigeration impairs platelet function. This limits their shelf life to 3 to 5 days. The usual dose used is 1 U/12 kg of body weight. Adult patients generally require six units at a time. Platelet units are pooled into one bag for ease of administration. Six units can be expected to raise the platelet counts by 30,000 to 50,000/μL in an average-sized patient. Single donor platelets are collected by apheresis from a single donor. One apheresis unit contains approximately 3 to 5×10^{11} platelets in 200 to 400 mL of plasma, equivalent to 6 U of random donor platelets. HLA-matched platelets are single donor platelet units obtained from donors who are HLA matched with the recipients. These are useful for patients who are refractory to platelet transfusions because of anti-HLA antibodies.

Indications for Platelet Transfusion

Platelet transfusions are commonly used in the management of thrombocytopenic patients. Practice guidelines for platelet transfusions have been published.[29] The threshold platelet count below which transfusion should be considered (transfusion trigger) varies depending on the etiology of thrombocytopenia and the presence or absence of bleeding. Randomized trial data suggests that a trigger of 10,000/μL is equivalent to a trigger of 20,000/μL in acute myeloid leukemia.[30] The American Society of Clinical Oncology (ASCO)[31] has recently published practice guidelines with recommendations for platelet transfusions in patients with cancer. Generally, prophylactic transfusions should be considered for platelet counts less than 10,000/μL because of the high risk of spontaneous bleeding below this level. Suggested platelet transfusion thresholds for various clinical situations are summarized in Table 4.

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Please see Ashok K. Malani's editorial on page 451 of this issue.

Even if you're on the right track, you'll get run over if you just sit there.

—Will Rogers