



Evaluation and management of anemia and bleeding disorders in surgical patients

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Anemia is commonly encountered and blood transfusion is frequently administered in the perioperative setting. The goals in the evaluation of an anemic patient are to determine the cause of anemia, assess its physiologic impact during surgery, and determine the need for its correction. Clinicians also commonly encounter patients at risk of bleeding. This article reviews the preoperative evaluation of anemia, physiologic consequences of anemia, and observational and clinical trial studies evaluating the efficacy of transfusion, and provides recommendations on the use of transfusion in the perioperative period. Also described is the approach to patients at risk for bleeding.

Anemia and red blood cell transfusion

The preoperative evaluation of the anemic patient

The basic work-up of an anemic patient includes a detailed history and physical, complete blood count with indices, a reticulocyte count, peripheral smear, and stool guaiac. With this information, a differential diagnosis is quickly established and further testing can be done to determine the specific etiology.

The history should focus on symptoms of bleeding, such as melena, hematochezia, hematemesis, hematuria, or significant blood loss during menses. Questions should be asked regarding a past medical history of anemia; need for blood transfusions; dietary habits; medications; and a history of

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hematologic, liver, renal, or endocrine disorders. Family histories of anemia, splenectomy, or early onset cholelithiasis place congenital hemolytic disorders higher in the differential diagnosis. The physical examination should focus on the skin for jaundice, mucous membranes for pallor, and examination for hepatosplenomegaly. Stool and urine should be checked for occult blood loss. Once an acute bleed has been ruled out, the reticulocyte count and mean corpuscular volume are the most helpful indices in determining the cause of anemia.

A hemolysis work-up is often indicated in patients with an increased reticulocyte count. This includes direct and indirect Coombs' tests, lactate dehydrogenase, indirect and direct bilirubin, and haptoglobin levels. Iron deficiency and thalassemia are the most common causes of microcytic anemias. Ferritin, serum iron, and total iron-binding capacity should be ordered in these patients. Further work-up involves hemoglobin electrophoresis to determine hemoglobin A₂ (in thalassemia minor) and a bone marrow biopsy to evaluate iron stores. Normocytic anemias are most commonly seen in neoplastic, chronic inflammatory, or infectious conditions. Work-up includes the aforementioned iron studies and an assessment of liver and renal function. Questions should also be asked regarding a history of medications or radiation that could lead to marrow suppression. Macrocytic anemias require an initial measure of vitamin B₁₂ and folate levels. Further assessment might include thyroid function tests, liver function tests, and a bone marrow biopsy.

Physiologic changes associated with anemia

It is helpful to understand some of the important physiologic consequences of anemia when making decisions regarding the need for its correction. Physiologic changes in the anemic patient aim to preserve tissue oxygenation in the setting of decreased oxygen-carrying capacity. One adaptation to anemia is an increased production of 2,3-diphosphoglycerate, which causes a shift to the right in the oxyhemoglobin dissociation curve [1–3], increasing the oxygen delivered to the tissues at a given P_{O₂}. Anemia also affects cardiac output. Many well-controlled studies have demonstrated an inverse relationship between hemoglobin levels and cardiac output [4–6]. There are conflicting data, however, concerning the hemoglobin level at which this occurs. Studies have shown a threshold hemoglobin level for this inverse relationship that varies from 7 to 12 g/dL [4]. In the setting of normal cardiac function, increased cardiac output is thought to be mediated by increased sympathetic activity and decreased blood viscosity. As a result, myocardial contractility and venomotor tone are augmented, and left ventricular preload and afterload are increased and decreased, respectively [7].

The body's cardiovascular and systemic response to acute blood loss is mediated by both the amount and rapidity of blood loss, and patient characteristics. The latter include age, comorbid illnesses, pre-existing volume

status, hemoglobin values, and the use of medications that have cardiovascular or peripheral vascular effects. Laboratory studies that investigated the effect of normovolemic anemia on the coronary circulation have shown that, in the setting of a normal coronary circulation, there are few consequences with hemoglobin levels as low as 7 g/dL [8–10].

Evidence pertaining to transfusion in the perioperative setting

Transfusion practices vary widely in the perioperative setting. Red blood cell transfusions are given to increase oxygen-carrying capacity. Two observational studies of orthopedic patients undergoing total hip and knee arthroplasty confirmed this variability [11,12]. Differences in transfusion practices have been attributed to several factors including lack of established transfusion guidelines [13], differences in the availability of autologous units for transfusions, and training differences between hospitals [14].

Risks and benefits must be weighed when making decisions and counseling patients regarding blood transfusions. Knowledge of the level of anemia at which blood transfusions prevent adverse outcomes is integral to the decision-making process. Studies in patients who declined blood transfusion provide important insights into the risk of anemia. In the largest consecutive series of patients who declined blood transfusion, the risk of postoperative mortality or morbidity rose as the preoperative hemoglobin fell below 10 g/dL and was substantially higher in patients with cardiovascular disease compared with patients without cardiovascular disease [15]. The risk was extremely high when the preoperative [15] and postoperative hemoglobin fell below 5 to 6 g/dL [16].

Two large observational studies evaluated the effect of anemia or transfusion practices in the perioperative setting [17,18]. The largest study involved a cohort of 8787 consecutive hip fracture patients who underwent surgical repair and who had postoperative hemoglobin levels less than 10 g/dL [17]. In this study hemoglobin levels as low as 8 g/dL did not seem to affect 30- or 90-day mortality, suggesting that this level might be safe in orthopedic surgery patients. Another study looked at 2202 patients undergoing coronary artery bypass graft surgery [18]. In this study patients were divided into three groups based on their hematocrit level when they entered the intensive care unit. The groups were designated as high (hematocrit $\geq 34\%$), medium (hematocrit 25% to 33%), or low (hematocrit $< 24\%$). Interestingly, patients in the high group were more than twice as likely to have a myocardial infarction as patients in the low group.

Ten randomized clinical trials exist that compare the effects of different transfusion thresholds [19]. Three of these investigated patients in the perioperative setting. One study looked at 428 patients undergoing first-time elective coronary artery bypass surgery [20]. The patients were randomized to transfusion triggers of 9 g/dL versus 8 g/dL. The event rates were low and no differences in mortality or morbidity were detected between the two

groups. Another trial involved 127 patients undergoing knee arthroplasty [21]. Patients were randomized to receive either two units of autologous packed red blood cells immediately after surgery or to receive autologous blood if the hemoglobin level fell below 9 g/dL. The mean difference between the two groups in postoperative hemoglobin levels was 0.7 g/dL. Again, there were no differences in outcome. A third pilot study evaluated 84 hip fracture patients who were undergoing surgical repair [22]. They were randomized to a 10 g/dL transfusion threshold versus transfusion for symptoms or if the hemoglobin level was less than 8 g/dL. The lowest hemoglobin level in the symptomatic group was 8.8 g/dL and the highest level in the threshold group was 11.1 g/dL. No significant differences were found between the groups for functional recovery, mortality, and morbidity. Sixty days after surgery, however, there were five deaths in the symptomatic group and two deaths in the 10 g/dL group.

The only study that is adequately powered to evaluate clinical outcomes relative to anemia and transfusion practices is the Transfusion Requirement in Critical Care [23]. Although this study involved patients in the intensive care unit rather than in a perioperative context, the authors believe it nonetheless provides valuable information. In this study, 838 volume-resuscitated intensive care unit patients were randomized to either a restrictive or liberal transfusion threshold. The restrictive group received allogeneic red blood cell transfusions at hemoglobin levels of 7 g/dL and then was maintained between 7 and 9 g/dL, whereas the liberal group received red blood cells at hemoglobin levels of 10 g/dL and was maintained between 10 and 12 g/dL. The mean hemoglobin levels in the two groups were 8.5 and 10.7 g/dL and the average numbers of red blood cell units transfused were 2.6 and 5.6, respectively. Although the findings were not statistically significant, the 30-day mortality was lower in the restrictive transfusion group (18.7% versus 23.3%).

Transfusion in patients with cardiovascular disease

The presence of cardiovascular disease reduces tolerance to anemia. Healthy animals can tolerate hemoglobin levels between 3 and 5 g/dL after normovolemic hemodilution [24]. In animals with experimentally induced coronary stenosis varying from 50% to 80%, however, ST-segment changes or locally depressed cardiac function occurred at hemoglobin levels in the range of 7 to 10 g/dL [25,26]. These findings were confirmed in 1958 adult surgical patients who decline blood transfusion for religious reasons. Mortality rates rose as hemoglobin levels fell and were substantially higher in patients with cardiovascular disease than those without cardiovascular disease [15]. These results suggest that anemia is not tolerated as well in the presence of cardiovascular disease.

Several observational studies also suggest that patients with cardiovascular disease are benefited by maintaining higher hemoglobin levels. In an analysis of Medicare claims data in 78,974 patients 65 years of age and older

with acute myocardial infarction, mortality was lower in patients who received a transfusion with hemoglobin less than 11 g/dL than patients who did not receive a transfusion [27]. These findings were consistent with two small studies in surgical patients. Patients undergoing a prostatectomy or vascular surgery with hematocrit levels less than 28% and who received blood transfusion had fewer cardiac events than patients not receiving transfusion [28,29]. There are no randomized clinical trials that have evaluated transfusion thresholds in patients with cardiovascular disease.

Correction of specific anemias

Nutritional deficiencies are usually easy to treat. Oral iron supplements correct iron deficiency anemia within 2 to 3 months and increase the reticulocyte count within 10 days. Parenteral vitamin B₁₂ or oral folate therapy can lead to an increased reticulocyte count in 3 days and correct the anemia within several weeks. Erythropoietin is used for anemias from radiation, chemotherapy, or chronic renal failure. Full recovery can take weeks to occur.

The use of blood transfusion in the preoperative care of patients with sickle cell disease is controversial. Sickle cell anemia, the most common hemoglobinopathy in the United States, is caused by a point mutation leading to a structural defect of β -globin. Patients suffer from recurrent painful crises as a result of vaso-occlusion from clusters of sickled red blood cells. As a result, patients can have significant organ dysfunction, especially of the heart and liver. A recent randomized study examined perioperative complications in patients who received a conservative transfusion regimen versus patients who had an aggressive regimen [30]. The former group was transfused to a hemoglobin level of greater than 10 g/dL, whereas the latter underwent exchange transfusion to achieve hemoglobin S less than 30%. No difference in adverse outcome was noted between the two groups, although the group transfused to 10 g/dL had fewer transfusion-related complications. Most patients in the study, however, were neither at high surgical risk nor did they undergo high-risk procedures. The authors suggest avoiding transfusion for minor procedures but transfusing to hemoglobin greater than 10 g/dL for moderate high-risk procedures.

Thalassemias are caused by ineffective hemoglobin production. Patients with thalassemia minor are usually at low risk and the decision to transfuse should be based on considerations used in other patients with anemia who do not have thalassemia. Thalassemia major patients often have multiorgan dysfunction as a result of iron overload from many transfusions. These patients need very careful assessment of their cardiac, pulmonary, renal, and hepatic function when considering transfusion.

Autologous blood transfusion

The advent of autologous blood donation coincided with the recognition in 1982 that HIV could be transmitted by blood transfusions. As a

result, the number of autologous blood donations for elective surgeries increased from fewer than 5% 15 years ago [31] to 50% to 75% for certain procedures [32].

When making decisions regarding autologous blood donation, patients need to be informed of the advantages and disadvantages. Advantages include the prevention of transfusion-transmitted infectious disease, the avoidance of red-cell alloimmunization, the prevention of some adverse transfusion reactions, and the provision of compatible blood for patients with alloantibodies [32].

Many of the risks of allogeneic blood transfusions, however, are also found in autologous transfusions. These include bacterial contamination, volume overload, and administrative errors regarding ABO incompatibility causing hemolysis [33]. One study showed a risk of adverse reactions severe enough to cause hospitalization in autologous donation (1 in 16,783) to be 12 times that of the risk in healthy volunteer donations [34]. The fact that autologous blood donation costs more than allogeneic [32] and that up to half the autologous blood that is collected is discarded [35] must also be taken into account. Furthermore, donating blood before surgery increases the risk of postoperative anemia and the likelihood of the need for transfusion [32]. Autologous predonation only reduces allogeneic blood exposure if between the time of donation and surgery the patient replaces some of the blood donated. Administration of erythropoietin at the time of predonation is an effective but expensive method to stimulate production of red blood cells.

Despite the widespread use of predeposit autologous transfusion, the authors advise against its use unless it is combined with erythropoietin. It should also be reserved for patients with anticipated blood loss large enough to require allogeneic transfusion.

Guidelines for transfusion

There are limited data to guide transfusion decisions in the perioperative period (Table 1). The only adequately powered randomized clinical trial

Table 1
Indications for red blood cell transfusion

Clinical situation	Transfusion threshold
Cardiovascular disease	9–10 g/dL
Symptoms of anemia (cardiac chest pain, congestive heart failure symptoms, orthostatic hypotension unresponsive to fluids, weakness)	When symptoms develop
Bleeding patient	Initiate if anticipated blood loss will result in hemoglobin level below transfusion threshold or rapid bleeding
Otherwise stable patient	Consider if hemoglobin level < 7 g/dL

regarding risks of anemia involved intensive care unit patients; it showed that it was safe to withhold red blood cell transfusions until the hemoglobin fell below 7 g/dL. There are insufficient studies involving patients with cardiac disease, but the weight of the evidence suggests patients may benefit from higher blood levels. The decision to transfuse should take into account whether the patient is actively bleeding and the presence of symptoms. In patients who are actively bleeding, an estimate of the rate and degree of blood loss must be made and measures must be taken to stop the bleeding. Blood should be given at the estimated rate of blood loss.

It is the authors' opinion that a transfusion threshold of 7 g/dL can be used in patients who are asymptomatic and who have no underlying cardiovascular disease. In patients with cardiovascular disease, a higher transfusion threshold of 9 to 10 g/dL is recommended. Symptomatic patients should be transfused to a hemoglobin level that relieves their symptoms. One unit of blood increases the hemoglobin level about 1 g/dL and the hematocrit by 3%. In most patients 1 unit of blood is given over 1 to 2 hours, but in patients at risk of fluid overload, the rate of transfusion should be reduced to 1 mL/kg hour. In addition, furosemide can be given to such patients before transfusions. After each transfusion the patient should be reassessed and a hemoglobin level measured.

Bleeding disorders

Preoperative testing

A careful history and physical is the most important component of the assessment for bleeding disorders in the preoperative setting. The history should include questions regarding a personal or family history of bleeding tendencies. Histories of bleeding after dental extractions or surgeries are particularly relevant. Pertinent questions also address any history of hematuria, menorrhagia, gastrointestinal bleeds, easy bruising, epistaxis, and hemarthroses. Knowledge of the patients' medications, medical conditions (especially hematologic, liver, or kidney diseases), and any unusual dietary habits is also essential. The physical examination should focus on the skin and mucous membranes, looking for evidence of bruises, petechiae, or bleeding. Adenopathy, hepatosplenomegaly, and signs of hepatic insufficiency, such as jaundice, telangiectasias, and gynecomastia, should also be assessed. The decision regarding which preoperative coagulation tests are needed is then based on this information in combination with the knowledge of the type of procedure being performed.

Patients with a normal bleeding history and physical examination who undergo low-risk procedures do not need preoperative coagulation screening. Several studies have led to this conclusion [36]. In one study, prothrombin time (PT) was measured on 301 patients admitted to a Veterans' Administration hospital who had been screened during a history and

physical examination for liver disease or bleeding disorders. Only 1 of 107 patients with a negative history and physical examination had a prolonged PT. In contrast, 41 of 121 patients with a positive history or physical examination had a prolonged PT [37]. Another study showed no predictive value in partial thromboplastin time (PTT) screening to predict postoperative bleeding in low-risk patients, although it did have some predictive value in higher-risk populations.

The value of preoperative coagulation tests in patients with normal bleeding histories who undergo high-risk procedures, such as cardiac, vascular, and emergency procedures, is also questionable. Most texts recommend at least a platelet count, PT, and PTT in such patients. One retrospective study, however, found frequent abnormalities in preoperative tests of hemostasis, yet they did not need more transfusions than patients with normal tests [38]. It seems the main use of preoperative tests of hemostasis is to obtain baseline values to help evaluate bleeding problems that occur after cardiopulmonary bypass and to monitor anticoagulation.

Preoperative coagulation studies are indicated if the patient has a history of abnormal bleeding or cannot provide a history, if the surgery is high risk for bleeding complications, if the patient has liver disease or malabsorption, or if the patient uses anticoagulants. It has been suggested that patients with histories of possible bleeding problems should have fibrinogen and von Willebrand's factor panel checked in addition to the PT, PTT, and platelet count [39]. Further testing is then based on the results of these tests. Other tests that might be considered include thrombin time, platelet aggregation, α_2 -antiplasmin, and factor XIII assays. The bleeding time has been shown not to correlate with surgical bleeding complications [40]. Furthermore, when performed by inexperienced staff, results are unreliable. Patients with highly suggestive histories might need extensive testing to elucidate the bleeding diathesis.

Management of patients with known coagulopathies

Coagulation is achieved by the interaction of three major components: (1) the vascular endothelium, (2) coagulation proteins, and (3) platelets. Table 2 summarizes some common causes of abnormal coagulation tests. Intact hepatic activity is essential for adequate coagulation, because all the coagulation proteins except factor VIII are primarily synthesized in the liver. A prolonged PT reflects a defect in the extrinsic pathway and is usually caused by hepatic insufficiency or a vitamin K deficiency from poor absorption, nutrition, or cholestasis. It can usually be corrected by a 10-mg injection of vitamin K. Vitamin K is ineffective, however, if impaired hepatic synthesis exists. A prolonged PTT reflects a deficiency in the intrinsic pathway. If a prolonged PTT is detected, further work-up should include a 1:1 mixing of patient plasma and normal plasma. If the PTT corrects, a factor deficiency is most likely implicated; if there is no correction, the presence of

Table 2
Differential diagnosis (selected) of bleeding disorders based on results of coagulation studies

Abnormal result	Differential diagnosis
Prolonged prothrombin time	Liver disease, vitamin K deficiency, severe factor VII deficiency
Prolonged partial thromboplastin time	Deficiency of factor VIII, IX, XI, or XII; lupus anticoagulant; von Willebrand's disease
Prolonged prothrombin time and partial thromboplastin time	Disseminated intravascular coagulation, deficiencies of factors II, V, or X; coagulation factor inhibitor
Prolonged bleeding time	von Willebrand's disease, thrombocytopenia, functional platelet disorders
Thrombocytopenia	Pseudothrombocytopenia, splenic sequestration, decrease production, increase destruction

a factor inhibitor or lupus anticoagulant is more likely. Specific factor assays can be done to assess for deficiency and further specialized tests are needed to assess for the factor inhibitors.

Surgery must be planned carefully in patients who have coagulation factor disorders. The most common inherited factor deficiencies are hemophilia A and B, which are caused by deficiencies of factor VIII and IX, respectively. Hemophilias occur in mild, moderate, and severe forms, correlating with factor levels of 6% to 30%, 2% to 5%, and 1%, respectively [41]. Patients with mild hemophilia usually only bleed after surgery or trauma. Laboratories that can measure factor levels rapidly and easily should be present in all hemophiliacs undergoing surgery. Patients should also have preoperative screening for factor inhibitors. A target of 100% factor VIII has been set for the first 5 to 7 days postoperatively in major surgery and for 50% after postoperative day 1 in minor surgery [42]. Recombinant factor concentrates and plasma concentrates can both be used, although recombinant factors are preferred in mild hemophiliacs who have had little exposure to blood products. Patients with mild hemophilia undergoing low-risk procedures can be treated with desmopressin (DDAVP), which increases the release of von Willebrand's protein and circulating levels of factor VIII [42]. Patients with hemophilia B are treated similarly to those with hemophilia A. Antifibrinolytics are to be avoided in such patients, however, because factor IX concentrates contain small amounts of activated clotting factors, which increase the risks of thrombosis.

Patients with hemophilia C (factor XI deficiency) have variable tendencies to bleed, which often do not correlate well with the factor level [42]. Fresh frozen plasma usually contains adequate amounts of factor XI for replacement, although a plasma-derived virally inactivated factor XI concentrate also exists. The concentrate, however, has been found to be thrombogenic in certain individuals and, if used, a target of 70% of factor levels

should not be surpassed. In patients with acquired inhibitors of coagulation factors, efforts need to be made both to achieve immunosuppression of the antibodies and to replace the affected factors. High-dose steroids, intravenous immunoglobulins, and alkylating agents can be used for immunosuppression. Patients with a lupus anticoagulant are not at increased bleeding risk, but instead have an increased risk of thrombosis. These patients should also be checked for thrombocytopenia and often require deep venous thrombosis prophylaxis.

Thrombocytopenia

Significant platelet abnormalities are infrequent but can lead to life-threatening bleeding [43]. If a patient is thrombocytopenic, pseudothrombocytopenia caused by platelet aggregation is excluded by direct examination of the peripheral smear. Thrombocytopenia in a patient with splenomegaly is caused by splenic sequestration and these patients rarely have clinical bleeding because their total platelet mass is normal [44]. Massive transfusion may lead to dilutional thrombocytopenia.

Thrombocytopenia can be caused by increased platelet destruction or decreased platelet production. Surgery must be delayed in these patients until the underlying illness is corrected. In disseminated intravascular coagulation, it is essential to correct the underlying disorder (ie, sepsis). Thrombotic thrombocytopenic purpura and hemolytic uremic syndrome are related syndromes accompanied by thrombocytopenia, microangiopathic hemolytic anemia, renal failure, and neurologic abnormalities. Treatment is difficult and involves total plasma exchange with cryoprecipitate supernatant plasma in the replacement fluid. In idiopathic thrombocytopenia purpura, platelets are destroyed by antibodies. These patients are treated with intravenous immunoglobulin, corticosteroids, immunosuppressive agents, and occasionally splenectomy. Before surgery, platelet counts of 80,000 to 100,000 are sought.

Drugs must be always considered when evaluating the cause of thrombocytopenia. The usual mechanism is destruction of platelets by antibody formation. This binding is usually weak and reversible, however, so cessation of the drug should lead to resolution of the thrombocytopenia. In conditions causing thrombocytopenia from decreased platelet production, patients can be transfused if necessary.

There is limited evidence to guide platelet transfusions. A report by the American Society of Anesthesiologists' Task Force on Blood Component Therapy in 1996 recommends that the decision to transfuse platelets should be made after taking into consideration not only platelet count but also various other factors [45]. It was suggested that platelet transfusion is rarely indicated when thrombocytopenia is caused by increased platelet destruction, or if platelet count is greater than 100,000. For platelet counts from 50,000 to 100,000 the decision should be made based on the risk of bleeding.

Platelet transfusion is indicated in a bleeding patient with platelet count less than 50,000.

Platelet dysfunction may lead to bleeding in the perioperative time period. Bleeding time is a measure of platelet function and is indicated in a patient with mucocutaneous bleeding and normal PT, PTT, and platelet count. If prolonged then further studies are needed to evaluate von Willebrand's factor and platelet aggregation studies [46,47]. These tests should be performed in patients with a high clinical suspicion even with a normal bleeding time [48,49]. The bleeding time is not a useful preoperative screening test because results are variable, and not highly predictive of perioperative bleeding [40].

Drugs are the most common cause of platelet dysfunction. Aspirin is the most common drug to cause irreversible platelet inhibition and should usually be stopped 5 to 7 days before surgery. Nonsteroidal anti-inflammatory drugs, vasodilators, and calcium channel blockers have a milder and reversible effect on platelet function.

Von Willebrand's disease is the most common inherited coagulation disorder with prevalence in the general population of 1% [50]. Platelet adhesion and aggregation are dependent on von Willebrand's factor. Von Willebrand's disease occurs when von Willebrand's factor is deficient or qualitatively abnormal. Type I is the most frequent category of disease and caused by reduced functional von Willebrand's factor. DDAVP is recommended for diagnostic procedures and mucosal biopsies, but a factor VIII concentrate that contains a high concentration of high-molecular-weight von Willebrand's factor is recommended for therapeutic procedures. Type II is caused by a qualitative abnormality and type III is the most severe and caused by markedly reduced levels of von Willebrand's factor in the plasma. Type II and III both need a concentrate of factor VIII and von Willebrand's factor.

Renal disease is another very common cause of platelet dysfunction. Patients with either acute or chronic renal insufficiency may have increased bleeding [51], but some of these patients may actually be hypercoagulable [52]. If there is active bleeding, the treatment options include correction of anemia, DDAVP, cryoprecipitate, estrogens, or dialysis. In the dialysis patient undergoing surgery, the timing of dialysis with heparin must be coordinated so that the coagulation profile returns to normal before surgery. In emergent cases, however, protamine may be administered.

Summary

The perioperative period offers a unique hemostatic and physiologic challenge. Evaluation of anemia and the decision to transfuse play an important role in the perioperative period. Achievement of adequate hemostasis is important. A bleeding-oriented history and physical, along with some

baseline tests, may help alert the physician to the possibility of a bleeding disorder. Finally, some patients may need correction of their bleeding disorder before surgery or careful monitoring in the perioperative period.

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