Common Surgical Diseases

Second Edition

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An Algorithmic Approach to Problem Solving

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This book is dedicated to my wife, Beth, for her infinite patience, love, and support, and to our son, Jack, for his never-ending curiosity and boundless energy.

Jonathan A. Myers

To my parents, John and Joan, for making it all possible.
To my wife, Janet, for her never-ending understanding and support of my career and, finally, to my children, Keith, Michael, Kyle, Kameron, Samantha, and John, for inspiring my optimism for the future.

Keith W. Millikan

I dedicate this to the physicians and healers whose work and lives have been a constant source of inspiration for me and countless others. May their memory be eternal.

Theodore, Neofytos, John, Cosmas, Damian, Panteleimon, Nektarios, Savas, Herman, Rose.

Theodore J. Saclarides

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Jonathan A. Myers
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Foreword

The printing of the 2nd edition of *Common Surgical Diseases: An Algorithmic Approach to Problem Solving* attests to its usefulness and popularity. Dr. Steven Economou, who wrote the first foreword, died on April 7, 2007, and despite his prolonged and debilitating illness, he retained his cheerful and optimistic nature. Those of us who have been mentored by this great human being hope to emulate, but will probably never achieve, his Olympian deeds as a surgeon, author, teacher, and leader. I am very honored to have been asked by the authors to write the foreword for the 2nd edition.

Years ago, the resident or medical student was commended for making a long list of obscure differential diagnoses regardless of the remoteness from the patient's problem. Of course, these diagnoses have to be excluded or confirmed by numerous investigations, which could be painful, time consuming, dangerous, and costly. One might say that having many diagnoses and performing many tests protects the physician from litigation. In fact, it will do the opposite if they are not appropriate and complications arise. Medicine has turned from performing too many investigations to expeditious and concise "evidence-based medicine." The authors have predated this trend by a few years and the printing of the 2nd edition is timely. *Common Surgical Diseases: An Algorithmic Approach to Problem Solving* is not only for residents and students or the young surgeon but also *for all physicians who deal with surgical patients*. After all, a nonspecialist may not know the intricacies of decision making for a Whipple operation and may order a percutaneous biopsy or an ERCP when, regardless of the result, the patient may or may not be a surgical candidate.

Common surgical diseases are not the only topics. There are at least 20 general topics on preoperative and postoperative care. Drs. Myers, Millikan, and Saclarides have taken advantage of the many talented attending physicians and residents at Rush University to write most of the chapters. The authors themselves wrote numerous chapters on their specialty. All the chapters were reviewed, corrected, and edited by the authors and they have left their indelible character in the text. This book belongs in the pocket of residents and students and on the desk of practicing physicians who deal with a wide range of patients.

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Part I
General Preoperative Considerations

1
Assessing Preoperative Cardiac Risk in Patients Undergoing Noncardiac Surgery

David M. Rothenberg

A. Emergency surgery. For the patient who presents with an emergency such as a perforated viscus or intraabdominal hemorrhage, surgery must be undertaken without delay. Clearly, in these instances, there isn't sufficient time to proceed with a cardiac workup; however, invasive monitoring may help perioperative fluid management.

B. Elective surgery. Minimizing perioperative morbidity and mortality is best achieved by performing a thorough preoperative evaluation. This is particularly imperative in patients with suspected coronary artery disease where an accurate history is 80–90% sensitive and specific in making a diagnosis. To determine the likelihood of intra- or postoperative cardiac complications, one must (1) identify preexisting or coexisting cardiac disorders, (2) assess the severity or stability of the cardiac disease, (3) maximize medical therapy, and (4) determine the likelihood surgery will place the patient at risk.

C. Major predictors. Major clinical predictors of cardiac complications are recent myocardial infarction (MI), unstable angina, decompensated congestive heart failure (CHF), severe arrhythmias (atrioventricular heart block, supraventricular tachycardia, and ventricular tachycardia), and valvular dysfunction (aortic stenosis). Patients with recent MI are at great risk for reinfarction and death, the risk is greatest when patients undergo elective noncardiac surgery within 6 months of the myocardial infarction. Patients with major predictors of cardiac complications should have their elective surgery rescheduled, while medical therapy is intensified and invasive testing such as angiography is considered.

D. Intermediate predictors. Intermediate predictors of cardiac complications include mild angina, prior myocardial infarction, compensated CHF, and diabetes mellitus. One of the most essential pieces of historical information is the degree of exercise intolerance, which is measured in metabolic equivalents (METs) (Table 1.1). Normal daily activity such as eating, dressing, or walking within the house requires 1–4 METs, while climbing a flight of stairs requires 4–10 METs. Patients unable to meet the 4-MET demands of a normal daily routine should be considered high risk for postoperative cardiac complications and should undergo a noninvasive evaluation with stress testing, nuclear imaging, and echocardiography to determine if angiography is needed. If these tests produce favorable results, surgery may be undertaken; otherwise angiography should precede surgery.

Certain surgeries carry a greater risk than others, particularly abdominal, thoracic, and major vascular surgery. This most likely relates to the more intense humoral stimulation and hemodynamic instability associated with these types of procedures. For example, patients with intermediate predictors who have greater than 4 METs but are scheduled for high-risk procedures should probably undergo noninvasive testing. If the procedure is considered low risk, surgery can be done without delay.

E. Minor predictors. Minor predictors of cardiac complications include advanced age, abnormal ECG, nonsinus heart rhythms, history of stroke, or uncontrolled hypertension. Again, cardiac evaluation is undertaken in consideration of the patient's functional capacity and the type of surgery planned. Patients with less than 4 METs who are scheduled for high-risk procedures should have noninvasive testing (see Algorithm).

F. Operate. On the day of surgery, patients should receive their cardiac medications and antihypertensives with a sip of water, although diuretics are often withheld to minimize perioperative hypovolemia. (If diuretics are being administered for the treatment of CHF, they may be given.) Antianginal medications (beta-antagonists), drugs used to treat CHF (digoxin- and angiotensin-converting enzyme inhibitors), are also given. Anticoagulants, however, must be withheld so as to prevent intraoperative hemorrhage. Coumadin, an anticoagulant used to prevent systemic embolization in patients with atrial fibrillation, must be discontinued 3–4 days prior to surgery, while intravenous heparin may be stopped 6–8 h prior to the operation. Patients with prosthetic heart valves should receive antibiotic prophylaxis to prevent subacute bacterial endocarditis (SBE). Patients with other valvular heart disease or congenital cardiac anomalies may also require SBE prophylaxis depending on the nature of the surgery. In general, preoperative antibiotics are given to patients with valvular

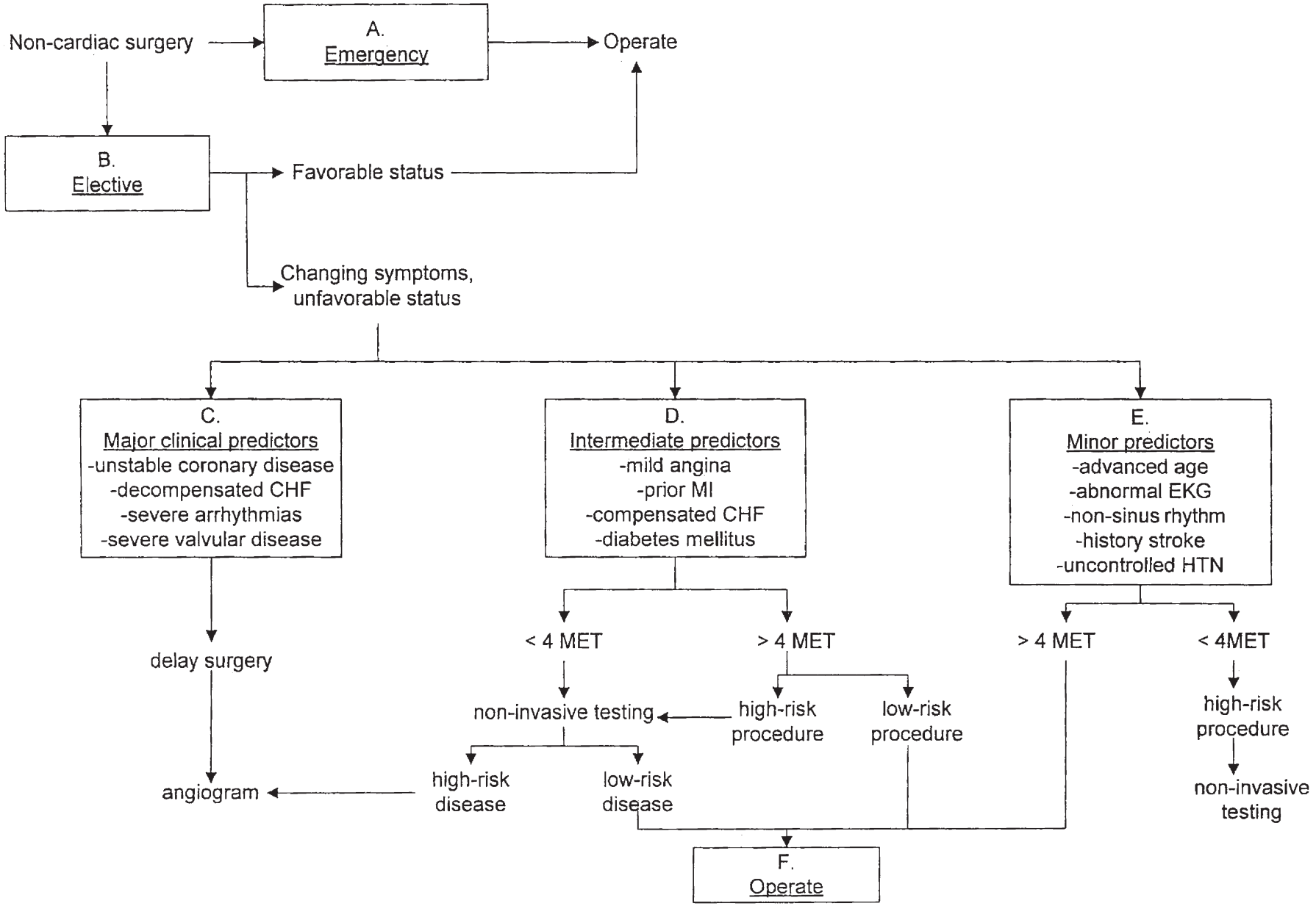
TABLE 1.1. Estimated energy requirements for various activities.

1 MET	Able to: Care for oneself	4 METs	Climb a flight of stairs or walk up a hill
↓	Eat, dress, or use the toilet	↓	Walk on level ground at 4 mph.
↓	Walk Indoors around the house	↓	Run a short distance
↓	Walk a block or two on level ground at 2–3 mph.	↓	Do heavy housework such as scrubbing floors, or lifting or moving heavy furniture
↓	Do light work around the house such as dusting or washing dishes	↓	Participate in moderate or recreational activities such as golf, bowling, dancing, doubles tennis, or throwing a baseball or football
↓		↓	Participate in strenuous sports such as swimming, singles tennis, football, basketball, or skiing
4 METs		>10 METs	

heart disease, prior valve replacement surgery, and congenital anomalies who undergo upper respiratory, genitourinary, or gastrointestinal surgery.

While there are no definite outcome studies regarding preoperative coronary revascularization (either with coronary artery bypass grafting or with coronary angioplasty), a select group of patients may benefit from one of these procedures prior to their elective noncardiac surgery. Patients undergoing major vascular surgery such as elective abdominal aortic aneurysm repair or carotid endarterectomy are those who often have improved outcome when myocardial revascularization is performed first.

Assessing Preoperative Cardiac Risk in Patients Undergoing Noncardiac Surgery



2
Management of Preoperative Bleeding Disorders–Intraoperative Coagulopathy

Jeffrey Shuhaiber and Jonathan Silverstein

The main contributors to hemostasis are the vessel wall (endothelium and subendothelium), platelets and circulating proteins with procoagulant and fibrinolytic activities. The surgeon may be the first to witness abnormal hemostasis and should know how to reach an immediate solution in a timely fashion.

Localized bleeding must be distinguished from diffuse bleeding that occurs spontaneously. The latter may be characterized by poor clot formation in the surgical field to extreme bleeding from previously hemostatic areas such as venipuncture sites. In many instances, the mainstay of treatment is functional and quantitative repletion of the deficient components. Even in the presence of coagulopathy, however, most bleeding complications are due to failure of local control in the operative field. Hypothermia, acidosis and shock should be identified and corrected as soon as possible. In the absence of a life threatening problem, the surgeon should terminate the operation to study, manage, and resuscitate the patient. The history can define hereditary or acquired factors. For the purpose of this discussion, preoperative work up and patient screening will be mentioned first followed by diagnosis and treatment of specific and common bleeding disorders.

A. Preoperative workup. It is important to identify hemostatic defects preoperatively so that surgery can be planned with appropriate hemostatic support. The assessment should inquire about history of bleeding problems, including spontaneous bleeding and following a hemostatic challenge (e.g., dental extraction or previous surgery). Liver disease and renal impairment should alert the clinician to a possibility of coagulopathy. Drugs such as aspirin, NSAIDs and warfarin may affect bleeding. Food like fish oil, red wine or garlic have been associated with a thrombocytopathy. A family history should be obtained remembering that hereditary conditions may miss generations and mild coagulation defects may become apparent only at times of extreme hemostatic stress. Clinical signs of bruising, skin purpura, petechiae or buccal mucosal hemorrhages should be recognized. More recently in females, menorrhagia has been associated with vWF deficiency.

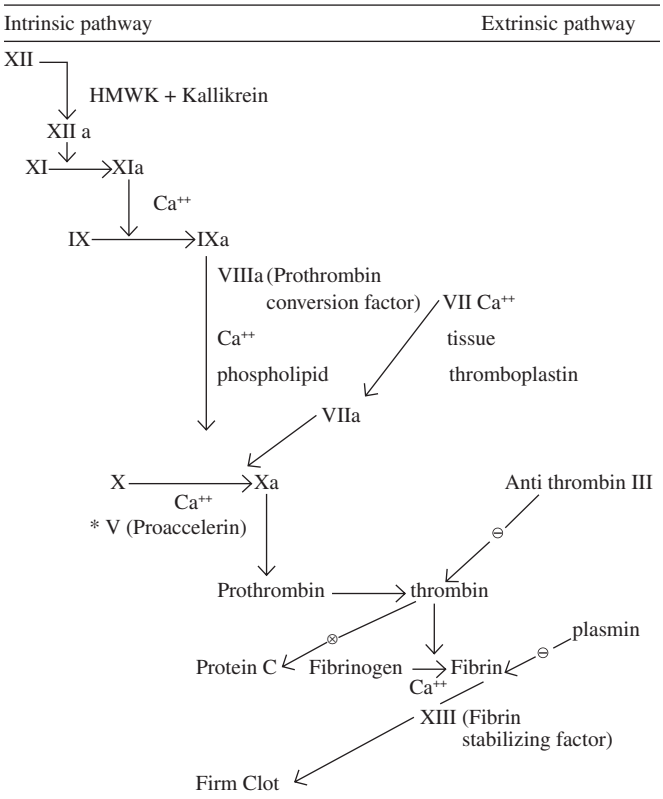
It is important to recognize that certain religions prohibit blood transfusion even when death is probable. The use of erythoropoietin, iron and autologous transfusion by normovolemic hemodilution or RBC saver machines should be considered in advance. The use of RBC substitutes have demonstrated promise in clinical trials but are not yet FDA approved.

Assessing the patient's drug history is important. NSAIDs and newer agents like clopidogrel and ticlodipine interfere with platelet aggregation either by inhibiting platelet thromboxane A2 or blocking the ADP receptor and thus decreasing platelet GIIb/IIIa expression. The effects can last up to 7 days. Patients taking heparin sq, low molecular weight heparin (LMWH) sq, or warfarin p.o. should be identified. Correction of coagulopathy can be performed slowly by halting these medications or acutely by fresh frozen plasma, Vitamin K and/or cryoprecipitate (factor VIII and vWF and fibrinogen rich). Protamine sulfate reverses heparin activity by liberating antithrombin III. (Table 2.1 represents coagulation cascade)

B. Diagnosis. When elective and sometimes emergent operations are required, the management of therapeutic anticoagulation prior to operation requires an assessment of the risks and benefits of discontinuing anticoagulation. The operation can be safely performed when the INR is less than 1.5. However, such a decrease will be associated with some increased level of thrombogenic activity. Acutely lowering the INR with fresh frozen plasma and vitamin K is appropriate when emergency operation is required. Under typical circumstances, the INR returns to normal within 3–5 days after medication is stopped. Subcutaneous heparin can be used to maintain the anticoagulation status and to protect against thromboembolic phenomena. However, the intravenous route of heparin has more predictable pharmacokinetics.

Diagnosis of bleeding disorders may be aided by thromboelastography (TEG), which measures overall coagulopathy and fibrinolytic function. TEG can measure blood clotting time, platelet and factor function, fibrinolysis and hypercoagulability. Another test, euglobulin clot lysis time (ECLT),

TABLE 2.1. Coagulation cascade.



Ca^{2+} is common catalyst

[a] Proteins C and S are inhibitors to VIII and V

measures the time for a clot to lyse and can be used if fibrinolysis is suspected.

Bleeding Disorders

C. Disseminated intravascular coagulation (DIC). It is a complex pathological process resulting from inappropriate activation of both the coagulation cascade and the fibrinolytic system. Precipitating causes include septicemia, fat embolism, massive hemorrhage and placental abruption. There is microvascular thrombosis in small arterioles resulting in tissue ischemia and end organ damage (e.g., renal failure) and subsequent consumption of platelets and blood coagulation factors causing generalized hemorrhage. In response to the tissue ischemia and in an attempt to maintain microvascular patency, excess plasmin is generated causing systemic fibrinogenolysis and local fibrinolysis. Classically, thrombocytopenia occurs, and INR, FDP, and D-Dimer are elevated. The ECLT has little value in DIC where clot formation and lysis are both abnormal. The decision to start replacing blood components does not depend not on absolute values, but on whether the patient is bleeding or is about to have a procedure. Treatment with platelets, fresh frozen plasma and/or cryoprecipitate should be given if there is clinically significant bleeding. The response (measuring PT, PTT, platelet count, fibrinogen level) should be monitored regularly. Heparin may be useful if the clinical problems are dominated by end organ damage but should be used in consultation with a hematologist.

D. Platelet abnormalities. Quantitative decline in platelets (thrombocytopenia) may be seen in sepsis, myeloma, large-volume blood transfusion, DIC, heparin-induced thrombocytopenia (either LMWH or standard heparin) and hypersplenism associated with idiopathic thrombocytopenic purpura. The underlying disorder should be treated and platelets should be replaced to a goal of between 20,000 and 50,0000. Quality of platelet function is altered by chronic uremia in end stage renal failure, Von Willebrand's disease (factor VIII R:WF deficiency), Glanzmann (GPIIb/IIIa defect), Bernard-Soulier (GPIb/IX/V defect), and Scott (defect in membrane thrombin formation) syndromes. Rare abnormalities in platelet secretion of ADP in dense granules or defective secondary mechanisms can also occur. Von Willebrand's disease can be inherited or acquired as in hematologic malignancies usually from development of antibodies against vWF or factor VIII. Treatment includes platelet transfusion or DDAVP that increases factor VIII and vWF levels especially in uremic patients. Note that type II vWD is dysfunctional factor while type III is absence of vWF altogether. Antifibrinolytics can also indirectly help by stabilizing any clot that has formed.

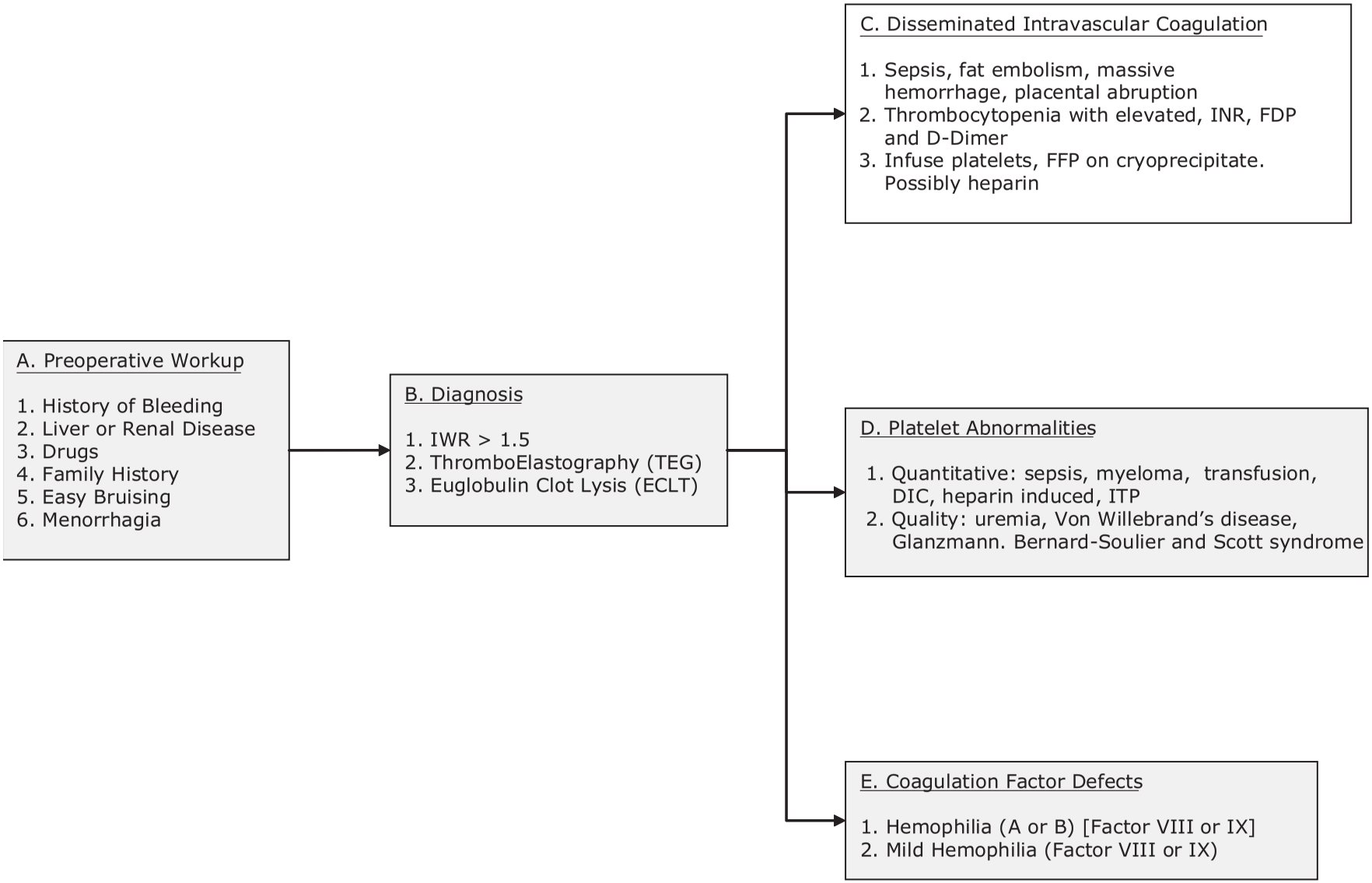
E. Coagulation factor defects. The most common hereditary defect of this type is hemophilia, which is an X-linked inherited deficiency of factor VIII (hemophilia A) or factor IX (hemophilia B). Mild hemophilia (factor VIII or IX levels 10–25% of normal) may be undiagnosed until unexpected postoperative bleeding occurs, but severe hemophilia ($<1\%$ normal) usually presents in infancy with spontaneous bleeding problems. Surgery in any hemophiliac patient must be planned and managed in cooperation with a hematologist experienced in such cases.

Before surgery, every hemophiliac patient should be screened for the presence of an inhibitor to factor VIII. Patients with hemophilia who do not have an inhibitor should receive factor VIII infusions just before surgery and will require daily monitoring so that the factor VIII level is maintained $>50\%$ for 10 to 14 days after surgery. When patients undergo joint replacement or other major orthopedic surgery, therapy should be continued for 3 weeks to permit wound healing and the institution of physical therapy. Following multiple transfusions, 10–20% of patients with severe hemophilia develop inhibitors to factor VIII. Inhibitors are usually IgG antibodies that rapidly neutralize factor VIII activity. Two types of inhibitors are found with different biologic characteristics and different clinical presentations.

For patients with hemophilia B, accurate laboratory diagnosis is critical, as it is clinically indistinguishable from factor VIII deficiency (hemophilia A), but requires different treatment. Either fresh-frozen plasma or a plasma fraction enriched in the prothrombin complex proteins is used. Monoclonally purified

or recombinant factor IX preparations are now available. In addition to the expected complications of hepatitis, chronic liver disease, and AIDS, the therapy of factor IX deficiency has a special hazard of causing thrombosis and embolism. As a result, some centers have returned to fresh-frozen plasma for factor IX-deficient surgical patients, while others have recommended the addition of small doses of heparin to the concentrate to activate antithrombin III during the infusion and reduce hypercoagulability. The recombinant or monoclonally purified products are less likely to be thrombogenic.

Management of Preoperative Bleeding Disorders–Intraoperative Coagulopathy



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Preoperative Nutritional Assessment/Intervention

Janet D. Millikan

A. Assessment. To prevent the morbidity and mortality associated with malnutrition, an evaluation of a patient's nutritional status early in their clinical course and again throughout the patient's treatment is essential. The most common nutritional deficiency is protein–calorie malnutrition, the least common is vitamin or mineral deficiency; multiple factors can contribute to either. The history and clinical examination may reveal obvious problems which lead to or result from nutritional deficits (i.e., poor dentition inhibiting oral intake; alopecia as a result of zinc deficiency). A review of current medical data and past medical history will identify conditions that influence nutritional status, such as chronic or acute disease states, surgery, chemotherapy, radiation therapy, and/or medications with possible drug–nutrient interactions. Diet history allows for the review of current oral intake with emphasis on eating habits and preferences, physical activity, and recent alterations in intake.

Stressed or catabolic patients may develop total or partial starvation quickly. Assessment of anthropometrics and somatic protein stores can determine severity of malnutrition. Severe weight loss over time can be categorized as follows: >2% in 1 week, >5% in 1 month, >7.5% in 3 months, and >10% in 6 months. More generally, significant weight loss is considered to be loss of 10–20% of usual body weight.

Deficits in nutrition-related lab values help identify the presence of malnutrition. Visceral protein levels are commonly used to evaluate nutritional status and become highly useful in determining protein stores as a direct indicator of nutritional intake; examples include serum albumin, thyroxine-binding prealbumin, and transferrin. Visceral protein stores can be affected by other factors, such as hydration status, which need to be considered during evaluation. Serum transferrin <150 mg dl^{-1}, serum albumin <2.5–3.0 ug dl^{-1}, and the prealbumin levels <10 mg dl^{-1} are considered significant deficits in terms of malnutrition. Evaluation of immunocompetence can be useful in nutritional assessment since total lymphocyte count less than 1,500 is an indicator of cellular immunity which is negatively affected by protein–calorie malnutrition.

B. Requirements. Accurately determining nutritional requirements, including energy, protein, electrolyte, and vitamin and mineral needs, is essential. Standardized equations or indirect calorimetry via metabolic cart assessment of oxygen consumption versus carbon dioxide release is typically used to determine calorie needs. Typically, 20–35 kcal kg^{-1} satisfy patients' energy requirements. Protein requirements are based on the amount protein necessary to maintain nitrogen balance. The recommended amount of protein for the healthy adult is 0.8 g kg^{-1}. Variations in requirements are due to stress- and disease-related limitations. Typical requirements for protein for the *surgical* patient are 0.8–2.5 g kg^{-1}. Nitrogen balance via urine collection or ongoing monitoring of visceral protein stores can be useful in evaluating adequacy of protein intake.

Various equations can be used to determine fluid needs, including 35 ml kg^{-1} if patient is <55 years of age, 30 ml kg^{-1} if patient is 56–75 years of age, and 25 ml kg^{-1} if patient is 75+ years of age. Careful monitoring for signs of overhydration and dehydration with use of supplemental fluids is necessary. Electrolyte requirements need to be evaluated on an individual basis and supplementation should be provided when necessary. Vitamin and mineral needs are typically based on Recommended Dietary Allowances.

C. GI tract functional? Preoperative determination of significant malnutrition necessitates early intervention via oral supplementation, tube feedings, or total parenteral nutrition (TPN). Parenteral feedings should be used when the gastrointestinal tract is deemed nonfunctional. General guidelines to determine significant malnutrition are based on visceral and somatic protein store depletion. A significant risk in TPN use includes catheter-related infections. Tube feeding use is dependent on tube availability and tolerance to formula introduction into the gastrointestinal tract. If immediate surgery is required and the patient will have an extended period without use of the gastrointestinal tract postoperatively, a central venous access device should be placed at the time of surgery. Alternatively, one may be able to postpone surgery to optimize nutritional status. Seven to ten days of full nutritional support prior to surgery

in those individuals with significant malnutrition is thought to improve outcomes.

D. *Specific formulations*. Determination of patient-specific enteral and parenteral formulations is necessary to meet the patient's nutritional requirements. Types of ready-made enteral formulas are preselected in most institutions and a volume appropriate to meet the patient's nutritional needs and restrictions should be ordered. Formulation of a patient-specific parenteral formula requires careful consideration and review of all components; nutrition support teams or other trained personnel can assist in TPN management. Dextrose is the principal source of carbohydrates and provides 3.4 kcal g^{-1}. Dextrose is available in 5, 10, 20, 30, 50, and 70% solutions. Maximal glucose infusion rate is 5 mg kg^{-1} min^{-1} and this rate should not be exceeded to prevent hyperglycemia. Additional calorie needs can be met with the addition of fat (9 kcal g^{-1}). Typical lipid use falls between 1.2 and 5 g kg^{-1}. Minimal fat needs are 2–4% of calories as essential fatty acids. Lipids are available in 500 cm^3 bottles of 10 and 20% solutions containing 550 and 1,000 kcal, respectively. Lipid solutions should be infused over 12 h or less to prevent bacterial contamination. Patients with hypertriglyceridemia (TRIG > 250 mg dl^{-1}) should not receive lipids. A test dose of lipids is typically given to ensure patient tolerance. Crystalline amino acids are the protein source in commercial TPN formulas and are available in 3, 3.5, 5, 5.5, 7, 8.5, 10, 11.4, and 15% solutions. Adapted amino acid solutions are available for patients with renal failure, hepatic failure, and trauma. Electrolyte additions to TPN are patient specific with common *initial* additions as follows: sodium 70–100 mEq, potassium 50–100 mEq, phosphorus 10–20 mmol, magnesium 3–8 mEq, calcium 10–20 mmol, and chloride and acetate to balance sodium load to prevent acid–base disturbances. Note that calcium and phosphorus provided in large amounts in TPN can combine to produce crystalline precipitate which may cause catheter occlusion. Vitamins, minerals, and trace elements should be added to meet the Recommended Daily Allowances with additional supplementation for documented deficiencies. Adequate water must be provided to prevent azotemia.

E. *Monitoring*. Monitoring protocols when using TPN are institution specific and include assessment of minerals, electrolytes, triglyceride levels, liver function tests, serum glucose, CBC with differential, PT and PTT, fluid inputs and outputs, weight, and visceral protein changes.

F. Initiation of TPN and gradual attainment of initial solution infusion goals over a 24-h period is typical. Once tolerance is demonstrated, TPN can be advanced to meet nutritional goals and cycled.

G. *Transition*. Discontinuation of TPN prior to surgery is imperative given the possible fluid and electrolyte shifts and stress-related factors associated with surgery. If the gastrointestinal tract can be used, tube feeding tube access should be considered and placed during surgery. Reevaluation of patients' nutritional needs and TPN formula postsurgery is prudent and should include adjustments for the metabolic changes associated with the surgery.