HEMATOLOGIC PROBLEMS IN SURGERY

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FOREWORD

The past decade has been a period of explosive progress in both hematology and surgery. Fortunately, many of the newer and complex operative procedures have been matched by supportive care which makes them possible. Many examples could be cited; the progressive improvement of pump oxygenators in open heart surgery to give acceptable reduction in defibrination and hemolysis represents a dramatic instance of collaboration between hematologist and surgeon. Other developments are perhaps less sensational but in total may offer a greater degree of benefit in everyday practice. The increasing refinements in blood component therapy, so that the patient receives the specific product he needs; the more definitive evaluation of the hemorrhagic state, both prior to and during surgery; the sharpening of indications for surgery in hematologic conditions; and the enhanced ability to diagnose anemias are all areas in which vast improvements are at hand.

Indeed, progress has been so rapid that even the specialist has trouble keeping up with his own field. Neglect of these many advances could imperil the patient and ultimately lead to inefficient use of resources and escalation of costs as well. A book which points out the highlights of the state of the art is therefore timely.

To some surgeons, this book will provide certain practical suggestions that can be used immediately. Aspirin is an agent which adversely affects platelet function and may be a cause of surgical bleeding, even several days after ingestion of only 600 mg. of the drug. Blood transfusion as a form of therapy is no panacea and should be used judiciously. Prior to elective surgery, anemias should be identified and characterized; specific therapy not only will restore the red cell mass but will lessen the operative risk for the patient as well. Routine transfusion for the anemic patient in preparation for surgery is poor practice. A careful history is the best insurance against an unexpected bleeder going to surgery without adequate preparation before

and during the procedure. Normal bleeding and clotting times give a false sense of security, and more sensitive screening procedures are now available to evaluate the possible bleeder who has been first detected by familial or personal bleeding symptoms. The book is replete with practical information in these categories.

But, ideally, surgeons and hematologists should form a permanent and continuous working team. The threshold for mutual consultation should be very low indeed, since problems may develop and evolve with great and often disastrous rapidity. Important for this working relationship is a broad overlapping of understanding in concepts, techniques, and vocabulary. It is hoped that this volume will help to bridge the communication gap between the two disciplines.

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PREFACE

This monograph grew out of the recognition that despite a plethora of books on hematology, there has been no single source to which the busy surgeon could turn for rapidly accessible, practical, unadorned information on hematologic problems of surgical patients.

After this monograph was conceived, the project of preparing the manuscript was almost abandoned when a number of books on bleeding and clotting became available, but these turned out to be far more esoteric and scholarly works. Despite their high quality, they still had not fulfilled the aim of our original concept, and so the task was resumed.

We felt that there was still need for a monograph which would discuss surgical decisions to be made when a patient with hematologic disease is stricken with another disease that may require surgical treatment, describe present-day alternatives on the role of surgery in the treatment or palliation of hematologic diseases, point up the close relationship between physiologic processes and hematologic changes, and offer the surgeon an overview of the most commonly encountered hematologic problems in surgery.

Our desire is that this book may be used with little effort by those who are not specialists in blood diseases. Books and articles written for hematologists are difficult for a surgeon to comprehend, let alone use as a rapid reference. Those written for clinical surgeons appear to have limited their usefulness by being either too broad or too deep. If all aspects of one problem, such as surgical bleeding, are covered at the expense of omitting other equally vexing hematologic problems in surgery, the work is at once too complete and too fragmentary. Moreover, if all abnormalities of the blood and tests for their detection are presented in detail to the harried surgeon, the book is a vehicle for hematologists and is impractical for surgeons.

We hope our effort holds a middle ground between these extremes. To accomplish this, we have kept references to a minimum, pared as much non-

surgical hematology away from the subject matter as we dared, and provided a rapidly usable index. The format of presentation of each subject is uniform to further promote usefulness and easy accessibility of material.

One can hardly pick up a surgical journal without finding at least one article on a hematologic subject. One can hardly attend a major surgical meeting without hearing a number of papers related to hematology in surgery. In fact, every surgeon, whether he knows it or not, is part hematologist, for he deals with abnormalities of the blood—potential or preexisting —in every one of his patients. He may encounter diseases of the blood in patients upon whom he must operate for a surgical disease, or he may be consulted to consider surgery for the treatment of a hematologic condition. Moreover, surgeons constantly deal with such prosaic problems of the blood as bleeding, anemia, and thrombosis.

Blood is the tissue most commonly encountered by the surgeon, almost regardless of his specialty. He should know at least as much about it as he does about other tissues.

Surgeons may say that this book is too hematologic; hematologists may call it too surgical. Both these possible responses were recognized at the outset as calculated risks. This book is for surgeons. Therefore, we believe it must risk being hematologically naïve rather than surgically useless, although we hope it is neither.

It became necessary for the coeditors to collaborate over a distance of 3500 miles when, in 1966, one of us (the hematologic member of the team) was stationed in Landstuhl, Germany, to serve as consultant in hematology to the U.S. Army, Europe Transfusion Service, while the other (surgical) partner was in New York. Happily, bits of manuscript crossed the Atlantic Ocean with regular frequency over a three-year period.

This preface will not have fulfilled its purpose unless it pays homage to those who made the monograph possible. Foremost, of course, are all the hematologic and surgical investigators through the years who have brought these two fields to their present status. Also, we must acknowledge that the progress that has brought hematology and surgery together is only part of a broader movement which has made all sciences and most arts more interdependent than ever. To illustrate the point, one need only contemplate the impact of such diverse fields as immunology, materials research, and bio-engineering, among others, on the accomplishments in surgery today. Surgeons recognize their debt to hematologists, as well as their debt to bacteriologists, chemists, physicists, and many other nonsurgical investigators.

For whatever value this book might have in helping to meet the daily problems of the busy surgeon, the authors are grateful to many people for their generous efforts. Among them, special recognition must be given to Dr. Theodore Spaet, Director of the Department of Hematology at Montefiore Hospital and Medical Center, and to Dr. Parviz Lalezari, Director of its Blood Bank Unit; they contributed greatly to the potential value of this book.

Four chapter were written by authors other than the undersigned. They are: Blood Transfusion During Surgery, by Drs. Deryck Duncalf and Patricia S. Underwood of the Department of Anesthesiology; Hematologic Complications of Organ Transplantation, by Drs. Kenneth Richards and Frank J. Veith of the Department of Surgery; Hematologic Changes Due to Extracorporeal Circulation, by Dr. Elliott Jacobson of the Department of Anesthesiology (all the preceding authors are on the staff of the Montefiore Hospital and Medical Center); and The Use of Frozen Blood for Transfusion, by Gerald S. Moss, of the University of Illinois College of Medicine. We believe each of these contributions is an important statement of the current state of knowledge in the areas described, written specifically for surgeons.

HAROLD LAUFMAN

ROBERT ERICHSON

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Section I

THE ANEMIAS

Blood-loss anemia, either acute or chronic, is by far the commonest form of anemia encountered by the surgeon. However, it is not enough for him to know that a patient who has been bleeding must be brought into "condition" to withstand anesthesia and surgery. It is equally important that he exercise judgment on how to correct the deficit in different types of patients, and how and when to administer volume replacement. He must weigh and balance these judgments in the light of the predictable effects of the surgical condition and its correction.

But blood-loss anemia is by no means the only kind of anemia the surgeon must face. Anemia due to impaired red cell production and that due to hemolysis or shortened red cell survival are becoming of greater and greater importance to the surgeon. Impaired production of red cells due to deficiency anemias may strongly affect surgical judgment. A number of diseases accompanied by intestinal malabsorption are now responsive to surgical correction. In addition, surgery on the gastrointestinal tract may produce malabsorption syndromes. The megaloblastic anemia of intestinal blind-loop syndrome may be a deterrent to certain surgical procedures.

Anemia due to hemolysis of erythrocytes has interested surgeons since the first successful human splenectomy was performed in 1887 in England by Spencer Wells. Wells operated upon a 27-year-old female patient with a history of intermittent jaundice since the age of nine. Curiously, this operation was performed three years before the disease, hemolytic anemia, was first described by Minkowski. The spleen of the girl weighed 11 lb., 4 oz., and she survived 40 years after surgery. Characteristically, the disease appeared in her only son, who developed jaundice, splenomegaly, and gallstones at the age of 14, at which time he was operated upon for obstructive jaundice as well as for hemolytic spherocytic anemia. The operation

performed by Wells was the first known surgical attempt to treat a hematologic disease.

Ever since the advent of blood transfusions, hemolysis has been known to be a complication of this procedure. As newer types of surgery appear on the scene, new vexing problems in hemolysis arise. Hemolysis caused by extracorporeal pumps, implanted artificial cardiac valves, and transplantation of organs is discussed in other chapters devoted to these special situations.

The three chapters in this section consist of the anemias broadly classified into their pathogenetic categories: blood loss, impaired red cell production, and hemolysis.

Chapter 1

BLOOD-LOSS ANEMIAS

By HAROLD LAUFMAN *and* ROBERT B. ERICHSON

SURGICAL IMPORTANCE OF ANEMIA DUE TO BLOOD LOSS

Common causes of blood-loss anemia are gastrointestinal lesions, such as peptic ulcer or malignancy, and trauma. The bleeding may be rapid enough to cause acute hypotension or slow enough not to be recognized easily as blood loss but rather as anemia of unknown cause.

The patient with active or recent bleeding presents a physiological problem that is completely different from that of the patient with bleeding which at one time in the past may have been severe, but has slowed or stopped. If the bleeding is active or recent, the decision for or against replacement by transfusion must be made. How much blood should be given? How rapidly? Should blood be given preoperatively or withheld for administration during surgery?

Reasons for arriving at a decision must be clearly understood. Although all factors in the decision cannot yet be quantified, some insight into the effects of blood loss on body processes is mandatory in order to institute rational therapy. Just as important as knowing when and how to administer blood is a knowledge of the potential risks inherent in blood transfusion. Equally important considerations are the age and general description of the patient, the nature of the disease process, and the rate of blood loss.

RAPID BLOOD LOSS

It is generally agreed that a young or middle-aged, otherwise healthy male with a normal blood volume can tolerate a rapid loss of 1500 ml. of blood while sitting up, without a great effect on his blood pressure, pulse, or respiration, and up to 2000 ml. blood loss if he lies flat. Therefore, if evidence of hypotension, sympathetic stimulation or other clinical evidences of shock are apparent in such a person, one can assume, even without laboratory data, that there has been rapid blood loss greater than these amounts. If such an individual loses blood slowly, that is, over a period of

24 or more hours, up to 40 per cent of blood volume (2000 ml.) may be shed without severe ill effects.

On the other hand, very young or very old patients, or patients with coronary, cerebral, or renal vascular insufficiency, or those with previously existing anemia can tolerate proportionately less rapid blood loss before they show evidence of acute circulatory insufficiency of the organ or organs concerned.

Similarly, a young, otherwise healthy male can tolerate fairly rapid overtransfusion of up to 1000 ml. of blood or plasma and show little or no ill effect. But older patients and those with impaired cardiac reserve cannot tolerate rapidly-induced hypervolemia and tend to develop high central venous pressure, circulatory failure, and pulmonary edema.

It must be realized that the infusion of blood definitely carries certain risks (see Chapter 9), and that full one-for-one replacement is ordinarily not needed for adequate circulation and oxygenation. Therefore, if blood loss has not been sufficient, nor the rate of loss great enough, to produce clinical signs of excessive acute blood loss, transfusion is best avoided or at least delayed. As early signs of circulatory instability appear, the decision to give blood may be made.

In the presence of slow or intermittent bleeding, the tendency to give blood the moment one low hematocrit reading comes back from the laboratory disregards the tenets of good clinical judgment. On the other hand, monitoring of the hematocrit is good practice in the presence of bleeding and helps in the decisions of blood administration, all other factors considered.

If maintenance of blood pressure is dependent upon blood administration in a patient with a bleeding lesion, the bleeding is assumed to be rapid, and blood should be replaced without delay. The blood may be given while preparations are made for surgical intervention.

It is apparent that the administration of blood in the presence of blood loss should be governed by the recognition of the pathophysiologic effects of rapid blood loss rather than by formula.

Pathophysiologic Effects of Rapid Blood Loss

The first obvious effect of acute hemorrhage is a reduction in total blood volume. Since whole blood, including its cells and plasma, is lost, anemia does not become apparent until capillary filling with tissue transudate takes place. This compensatory mechanism draws extravascular fluid into the vascular compartment and tends to correct the hypovolemia. It has been estimated that transcapillary filling may become evident as early as one half-hour after a rapid blood shed.

The earliest effects of rapid blood loss, then, are reflected in a hypovolemic state rather than in a lowered oxygen-carrying capacity of the blood. Rapidly-responding compensatory mechanisms, such as splanchnic and cutaneous vasoconstriction and increased cardiac and pulmonary work, are

mobilized to ward off circulatory collapse. If these responses are inadequate to support, first, the total circulation, and, next, specific organ circulation, the patient shows signs of circulatory collapse or organ failure. Weak, thready pulse, cold clammy skin, air hunger, hypotension, and hypothermia are the obvious clinical signs.

If bleeding stops before more than a critical amount of blood is lost, blood volume may be spontaneously restored in 12 to 48 hours, depending upon the state of protein nourishment of the patient and the rate and amount of the bleeding. Because restoration of blood volume is made with tissue fluid, the ratio of red cell mass to total circulating volume is proportionately reduced. The condition now prevailing is one of secondary anemia due to blood loss in which the blood cells are morphologically normal, but the hemoglobin, hematocrit, and red cell count values are low.

Within 24 to 48 hours after an acute bleeding episode, the peripheral blood begins to show evidence of active red cell regeneration. The stimulus for this phenomenon is apparently a humoral one, which the anemia itself imparts indirectly to the marrow, probably mediated through renal secretion of erythropoietin. If the marrow is normal, large numbers of stem cells begin to differentiate and enter the red cell compartment. If the nutritional and hormonal influences are adequate, red cell proliferation and maturation proceed steadily, and red cell generation time is not greatly altered. At 24 to 48 hours, active red cell generation is reflected in the peripheral blood by increased numbers of reticulocytes.

Within a week after an acute bleeding episode the reticulocyte count reaches its peak (5 to 15 per cent) and returns to normal within two weeks. If hemorrhage does not recur, and the patient's condition is otherwise considered normal, the peripheral blood will return to normal within six weeks or less, depending upon the severity of the bleeding episode.

Besides stimulating erythropoiesis, acute bleeding causes leukocytosis and increased platelet production, both of which become apparent within hours and last for a number of days. The degree of these alterations also depends upon the severity of the bleed.

DIAGNOSIS OF ANEMIA DUE TO SUBCRITICAL OR REPEATED BLOOD LOSS

Acute bleeding usually is readily apparent. Hematemesis, melena, menorrhagia or metrorrhagia, nosebleed, or some other obvious bleeding occurrence is usually a prominent feature in the recent history. Acute blood loss is always to be suspected with a patient in shock. Obscure bleeding into body cavities or tissues may present something of a diagnostic problem, but usually can be picked up by a combination of history and physical findings. An important feature in the history is the possible ingestion of drugs. Aspirin in large doses, for example, may cause gastric irritation, platelet damage, and bleeding. If there is a family history of anemia, it is necessary