THE SCIENTIFIC MANAGEMENT OF SURGICAL PATIENTS

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PREFACE

Rational therapy of surgical patients depends on knowledge of the biologic science of the disorders seen by surgeons. Surgeons need a ready source for updating their knowledge of basic science relevant to the problems of their patients. They must acquire this knowledge without periodically starting over as premedical students. Pertinent biologic science is broader than the usual subject matter presented as pathophysiology. However, a volume of reasonable size cannot cover exhaustively all the scientific information on which the practice of surgery rests. To focus this book on the knowledge essential to the surgeon, we have chosen clinical scientists rather than basic scientists to write these chapters.

The subject matter and the order of presentation were conceived to facilitate clinical correlation with biologic science. Some chapters, such as those in which cell and fluid balance are discussed, cover general topics relevant to all organs and systems; some, a system (the heart and circulation, for example); others, a single organ (the kidney). This organization recognizes that cellular function is basic to all biologic science; it also reflects the relevance to surgical disorders of the interaction of cells with cells, systems with systems, organs with organs, and the body with the external environment. The book concludes with a chapter about statistics to help the reader to judge the significance of new information.

Because the book is designed as an edited educational source book, not as an exhaustive review, each chapter is followed by a supplementary reading list, not by an extensive supporting reference list.

To assist the reader in correlating biologic science with clinical problems, we developed a tool for identifying the science relevant to clinical problems of interest. Use of this tool is presented in the Introduction to the Problem List.

As editors, we thank all our contributing authors for their chapters and help in revisions to meet our goals. Their names at the head of each chapter acknowledge their contributions.

It is harder to convey the essential contributions of Ann DeHuff Peters, who did major revisions on a number of chapters. She met with us during our editorial sessions and provided invaluable advice. As is true of all the writings of her husband, without Ann's editorial skill and patience, his chapters would never have reached the printed page. We are also grateful to Sue Seigal, who, in addition to the arduous tasks of keeping track of the chapter manuscripts, the reminders of deadlines, and so forth, helped with the editing and the typing of much of the book.

Lin Richter Paterson, George D. McKinnon, and Elizabeth M. Welch of Little, Brown and Company guided us in the work and were particularly helpful in transforming our concept of the Problem List into a workable system.

Other authors will know that our colleagues and families made this book possible by their tolerance for our neglect during its preparation.

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INTRODUCTION TO THE PROBLEM LIST

The practice of surgery is problem solving. The Problem List in this book is a tool to help the reader relate basic science information to patient care. To identify the relation of clinical problems to the text, the problems are annotated in four ways:

1. In the chapter outlines to provide an overview of selected clinical problems pertaining to the chapter as a whole.
2. In the text as insets to alert the reader to relevant clinical problems.
3. In the Problem List (p. xvii) to facilitate the reader's ability to relate the subject matter of the various chapters to a given clinical problem.
4. In the index at the end of the book.

By referring to the Problem List, the reader can elect at which level to examine a finding. For example, in considering hypoxia, the reader will recognize that it will be listed under the main topic, Repiratory Disorders. The reader will then turn to the Respiratory Disorders entry (presented in alphabetic order between Radiation and Sepsis) and find hypoxia listed (again in alphabetic order). As can be seen on page xxi, the reader will be led to discussions in Chapters 1 (The Cell), 5 (Pain), 6 (Response to Injury), 11 (Oxygenation and Acid-Base Balance), and 14 (The Lung). By following the lead of the Problem List, the reader derives an integrated view of the biologic science associated with hypoxia, a frequent clinical problem.

We have abridged a case from the American College of Surgeons Surgical Education and Self-Assessment Program (SESAP) III examination to illustrate the use of the Problem List. We have supplied (in italics) the descriptions of management decisions that were required in the exam. As you read the case, use the insets to find the selected components of biologic science necessary for optimum patient management.

PROBLEM 5

You are a general surgeon working in a well-equipped 500-bed suburban hospital. You respond to a call from the emergency department to see a 44-year-old woman who appears gravely ill and is writhing with severe abdominal pain. She was transported to the hospital in an ambulance. No one accompanied her.

PAIN

The patient's breathlessly short answers and a brief telephone conversation with her disinterested husband indicate that she has been ill for two weeks with increasingly severe abdominal pain. She initially noted a dull aching midabdominal pain and anorexia. By three to four days the constant pain spread throughout her abdomen, and she developed nausea with intermittent vomiting. The vomitus was brown, liquid, and malodorous.

DEHYDRATION

One week prior to admission she began having four to eight liquid stools each day. The volume and characteristics of the fecal material were not noted. Three days before admission she was unable to drink or to ingest anything without vomiting. She developed abdominal distention and became lightheaded, making it difficult to stand or walk. The increasingly severe abdominal pain led to her hospitalization.

She was taking phenothiazine (Mellaril) for chronic schizophrenia until three days before admission. She has taken oral contraceptives for ten years.

Examination reveals an apprehensive, obese (she reports 210 lb), tachypneic woman. Systolic blood pressure is 96, pulse rate is 140, temperature is 40°C, and respiratory rate is 30. A physician in the emergency department had placed an intravenous catheter in a vein in the left forearm, and introduced a urethral catheter that had yielded 32 ml of urine. She is receiving 5% glucose in 0.2% NaCl.

HYPOVOLEMIC SHOCK

Her lungs are clear on auscultation anteriorly. Heart size is not determinable, the rhythm is regular, and no murmurs are audible. Her abdomen is distended, and the abdominal skin is shiny and tense. Bowel sounds are absent, generalized abdominal tenderness is noted, and percussion for tympany produces distressing pain. Rectal examination reveals reduced sphincter tone and no masses, but tenderness and fullness anteriorly. A specimen of black liquid stool is hematest-positive.

A nasogastric tube is inserted and the administration of Ringer's lactate solution started. A blood culture, ECG, chest x-ray, and films of the abdomen are obtained.

FLUID THERAPY

Section B

Laboratory values, now available, are as follows: hemoglobin, 11.2 gm/100 ml; hematocrit, 34%; WBC, 28,300/cu mm, with 63% polymorphonuclear leukocytes, 27% segmented neutrophils, 7% lymphocytes, 2% monocytes, 1% metamyelocytes and adequate platelets; serum sodium, 134 mEq/liter; serum potassium, 2.8 mEq/liter; serum chloride, 94 mEq/liter; serum carbon dioxide content, 21 mEq/liter; BUN, 26 mg/100 ml; serum creatinine, 1.8 mg/100 ml; serum glucose, 332 mg/100 ml; and serum amylase, 18 units (normal, 4 to 25 units). Urine specific gravity is 1.026, pH is 5.0, protein is +2, glucose is +1, and ketones are negative. Arterial blood gases are Po_2, 96 torr; Pco_2, 39 torr; and pH, 7.33.

ACIDOSIS, METABOLIC

In the brief period after admission to the emergency department, vital signs and urine flow improve only minimally.

A central venous catheter and arterial line are inserted. The rate of fluid administration is increased and antibiotics are begun. 40 mEq of potassium are added to the Ringer's lactate solution.

Section C

During the next half hour, the pulse rate decreases to 120 and the blood pressure rises to 108/84. The rectal temperature is 39.2 C, and the patient excretes 30 ml of urine. The central venous pressure rises to 5 cm water.

OLIGURIA

The patient is admitted to the hospital for observation in the ICU preparatory to operation.

Section D

At the appropriate time, you proceed with celiotomy. Malodorous air is released as the peritoneum is incised. A diffuse fibrinopurulent peritonitis is present. An inflammatory mass is noted in the right lower abdomen. The stomach, gallbladder, liver, and duodenum are normal except for edema of the visceral peritoneum. The small intestine proximal to the mass in the right lower quadrant is distended and edematous; a pulse is palpable in the superior mesenteric artery at the base of the mesentery. All of the colon proximal

to the sigmoid is distended and thickened. As loops of small intestine are teased away from the mass in the right lower quadrant, an abscess confined to the pelvis and right iliac fossa by loops of small intestine and sigmoid colon is entered. A sample of purulent exudate is obtained for culture. Part of the wall of this abscess is composed of 43 cm of violaceous to black, necrotic terminal ileum with multiple perforations. Patches of subserosal black tissue are noted to 6 to 8 cm proximal to the junction of normal and necrotic bowel. The mesentery in this region is suffused with hemorrhage. The distal 1 cm of ileum and the cecum appear to be perfused normally. A bowel resection is performed, and as the mesentery is transected, clots are noted to extrude from the mesenteric veins.

SEPSIS, GENERAL

ILEUS

OXYGENATION, TISSUE

The necrotic segment of the ileum was resected. Ileostomy and distal mucus fistula are made because primary anastomosis was judged to be unsafe. The abscess was drained and the skin left to close by secondary intention.

SECONDARY HEALING WOUND

Section E

In closing the operative incision, an umbilical hernia is repaired. One unit of red blood cells and two units of whole blood are administered to replace an estimated blood loss of 900 ml. She is also given 11 liters of crystalloid over five hours. Urine flow averages 54 ml/hour. Arterial blood gases near the end of the operation are Po_2, 251 torr; Pco_2, 40 torr; pH, 7.28. Serum sodium is 132 mEq/liter and serum potassium is 4.1 mEq/liter.

TRANSFUSIONS, MULTIPLE

Upon admission to the intensive care unit, rectal temperature is 38 C, blood pressure is 130/72, pulse rate is 108, and respiratory rate is 18. Mechanical ventilation is established with an FIO_2 of 0.5 and tidal volume of 1200 cc. Intermittent mandatory ventilation is set at 8/minute and positive end-expiratory pressure (PEEP) at 5 cm water.

Forty-five minutes after admission to the intensive care unit, her temperature has increased to 39.8 C. Five minutes later, her temperature is 40.2 C, pulse rate is 142, respiratory rate is 34, and blood pressure is 102/82. She is perspiring profusely; her face and trunk have bluish mottling, her jaws are clenched, and her upper extremities are rigid. Her urine has become dark reddish and flow has decreased to 10 ml in the past 30 minutes.

SEPTIC SHOCK

A Swan-Ganz catheter is inserted and another blood culture is obtained.

Section F

Within 20 minutes, the patient's temperature is 41 C, pulse rate is 156, and cyanotic mottling is more apparent and generalized. Her systolic pressure is 90. The ECG monitor shows sinus tachycardia.

SEPSIS, GENERAL

Patient is put on cooling blanket. The rate of infusion of Ringer's lactate is increased, antibiotics are continued, and reoperation is considered.

Section G

The patient responds to treatment. Four days later the patient's condition is relatively stable. Temperature ranges from 37.4 to 38 C, pulse from 88 to 104, and blood pressure from 110/70 to 126/78. Central venous pressure ranges from 5 to 7 cm water and urine flow from 560 to 730 ml every eight hours. The ventilator is set at FIO_2 0.4 with a tidal volume of 1200 cc. Intermittent mandatory ventilation is 8/minute and positive end-expiratory pressure (PEEP) is 5 cm water. The arterial blood gases are Po_2, 86 torr; Pco_2, 41 torr; and pH, 7.41.

ARTIFICIAL VENTILATION

However, the patient is increasingly restless, complains of inability to "get enough air," and develops a temperature of 39.6 C. Breath sounds are audible bilaterally and anteriorly. The abdomen is rounded and tympanitic. Bowel sounds are absent, with guarding on palpation, particularly on the right side of the abdomen. The pulse rate has increased to 124, blood pressure has declined to 90/78, and urine flow has decreased to 22 ml in the past hour. The operative incision is clean and has early granulation tissue. The ECG monitor has not changed.

The diagnostic considerations include recurrent intraabdominal abscess, pulmonary embolus, and ARDS. Noninvasive tests do not identify an intraabdominal abscess.

SUBPHRENIC ABSCESS

Section H

The patient's condition improves. Pulse rate decreases to 114, blood pressure becomes 100/70, urine flow increases to 36 ml/hr, and body temperature subsides to 39.0 C.

The abdomen is reexplored and two abscesses are drained, after which the patient makes a satisfactory recovery.

We have used the Problem List concept, which is employed throughout the text, to analyze a complex case of intestinal perforation from SESAP III. We chose 14 problem-identifying insets; other readers might have chosen different insets more suitable to their interpretation and interests. The insets of our choice pertaining to this case from SESAP are pain; dehydration; hypovolemic shock; fluid therapy; acidosis, metabolic; oliguria; sepsis, general; ileus; oxygenation, tissue; secondary healing; transfusions, multiple; septic shock; artificial ventilation; and subphrenic abscess. Depending on the readers' interest, they may select any or all of these topics in the Problem List with the expectation that reading the text to which they are referred will result in an integrated review of the biologic science associated with the scientific management of this patient. Thus, the clinical problem notations provide a bidirectional method of correlating patient management with biologic science.

PROBLEM LIST

The clinical problems noted in the text are arranged alphabetically within this list under the following entries: