

Manual of Pediatric Therapeutics

Second Edition

Department of Medicine
Children's Hospital Medical
Center, Boston

Edited by
John W. Graef, M.D.
Thomas E. Cone, Jr., M.D.

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Little, Brown and Company
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Library of Congress Catalog Card No.
79-91941

ISBN 0-316-13911-4

Printed in the United States of America

HAL

Foreword

Who among physicians has not been stumped by an unusual complaint or has not been at a loss to know the appropriate medication for a given condition, or who would not welcome a quick consultation from someone more familiar with the problem at hand? It is the lot of all of us to seek authoritative advice from time to time.

Six years ago, Drs. Graef, Cone, and their many colleagues responded to that need with their highly successful *Manual of Pediatric Therapeutics*. The soft cover and spiral binding of the first edition was an implied statement that revisions would be forthcoming. In this new edition, the authors have updated or reorganized all chapters and have added chapters on adolescent gynecology and allergies.

This manual is designed to complement the more definitive textbooks and handbooks on pediatrics. Its origins were the notebooks of house staff, the "pearls" from the literature, and the accumulated wisdom of the faculty. Although no small volume can ever be the final word, the authors have done their best to summarize current practice as it takes place in the wards and clinics of the Children's Hospital Medical Center, Boston. They hope that their readers will find the second edition as useful as the first edition has been.

Mary Ellen Avery, M.D.
Physician-in-Chief

Preface

The gratifying response to the first edition of the *Manual of Pediatric Therapeutics* and the many helpful suggestions and comments from our readers have provided continuous encouragement throughout our preparation of the second edition. Nevertheless, the task of revision has been larger than we had anticipated, and the interval between the first and second editions longer than we had planned. We hope that this new edition, the result of many hours of rewriting and revision by our colleagues at the Children's Hospital Medical Center, will have been worth the wait.

The second edition is really a new book. Two new chapters have been added: Prepubertal and Adolescent Gynecology and Allergic Disorders. To make room for this new material, elements of the original chapter on special diagnostic problems have been incorporated elsewhere in the text (evaluation of hematuria in Chap. 9, vomiting in Chap. 11, immunodeficiency in Chap. 18, and headache in Chap. 21). The new, annotated *Manual of Clinical Problems in Pediatrics*, by Dr. Kenneth B. Roberts, we believe, fills the need for discussions of the evaluative aspects of clinical entities far more comprehensively than our space limitations permit.

Completely rewritten are chapters on renal, gastrointestinal, endocrine, and ear, nose, and throat disorders; and growth and development. New chapter sections include the sudden infant death syndrome (SIDS) and common psychiatric problems. In addition, all material that was retained from the first edition has been carefully reviewed, reedited, and updated.

Particular attention is called to the chapters titled Management of the Newborn, I and II, and Fluid and Electrolytes. These two areas, the "heart and soul" of contemporary pediatrics, have been completely rewritten to provide as much information as possible in the succinct format we utilize.

The material on the newborn is divided into two chapters. Management of the Newborn, I, discusses routine and emergency management of the full-term and the low-birth-weight infant. Management of the Newborn, II, discusses specific problems in the neonatal period, including respiratory, cardiac, hepatic, hematopoietic, infectious, and metabolic disorders. Obviously, there is considerable overlapping with other chapters, but with the exception of neonatal seizures (in Chap. 21), the specific discussions regarding the newborn can be found in these two chapters. (For a comprehensive guide to the management of newborns, the reader is referred to the *Manual of Neonatal Care*, by Drs. John P. Cloherty and Ann R. Stark.) The chapter on fluids and electrolytes is an up-to-date synthesis of current concepts in this field, and, unlike the majority of the chapters in the *Manual*, which can be read selectively, it is best read in its entirety.

The overall organization of the book has been changed as well. Although, as before, the first seven chapters are of general subject matter, the remainder has been organized into clusters of related disciplines. Thus, Fluid and Electrolytes (Chap. 8) is followed immediately by the chapters on renal, cardiac, and gastrointestinal disorders. Endocrine disorders, adolescent gynecology, and diabetes mellitus are clustered, followed by chapters dealing with infection and inflammation (Chaps. 15-19). The allergy chapter (No. 19) bridges those on inflammation

(Chap. 18) and pulmonary disorders (Chap. 20). The remaining chapters stand alone as close and important adjuncts to general pediatrics, and the emergency reference material on the inside front and back covers of the *Manual* should prove to be useful when needed.

Finally, a vignette and a caveat. One of the authors of this manual had occasion to consult its first edition for the treatment of thrush (oral candidiasis), one of the commonest of pediatric problems. Only at that moment did he discover (to his chagrin) that neither thrush nor oral nystatin was included and that he had to seek another source. Suffice it to say, thrush and idiopathic thrombocytopenic purpura (ITP), the other glaring omission from the first edition, are included in the second edition.

Like the first edition, however, the second cannot be, nor is it intended to be, a pediatric text. As before, evaluative material, though present, is kept to a minimum and intended *only* to guide the reader to utilization of the appropriate therapeutic plan. As a manual of therapeutics, the text is limited to discussion of those entities for which therapeutic guidelines can be agreed upon and whose benefits will clearly outweigh the risks of their misuse.

As before, the *Manual of Pediatric Therapeutics* is intended for use by pediatricians, family physicians, house officers, medical students, nurse practitioners, nurses, and nursing students. Availability of other reference material is assumed, and recognition that other therapeutic approaches used at other teaching institutions may be as effective as those described here is implicit.

In the preparation of this second edition, we owe thanks to many persons. Invaluable advice and editorial assistance were received from Drs. Barbara Howard, Joseph Gootenberg, Ira Gewolb, Robert Tuttle, and Robertson Parkman.

Help with manuscript preparation was provided by Josephine Antczak, Cynthia Krusen, and Margaret Sherman. But our most devoted, patient, and diligent help came from our secretary, Annette Cardillo, and our production editor, Anne Najarian-Merian, whose patience and wise guidance were unflagging throughout.

Used with care, it is our hope that the second edition will prove to be as useful to readers as the first edition has been.

J.W.G.

T.E.C., Jr.

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General Care of the Patient

I. CARING FOR CHILDREN Illness can be a frightening and unpleasant experience, particularly for children. Concern for the child's needs has helped to foster understanding of the impact of hospitalization on the child's growth and development. Hospital personnel are learning to consider how the child matures and learns, how he uses imagination and make-believe, the meaning of his toys and other possessions, and his capacity for adaptation to others. An older child may verbalize fear of an operation by angrily protesting the failure of a venipuncture. A 4-year-old may express the same feeling by mutilating a doll, and a 2-year-old, by biting other children or refusing to continue well-established toileting. Understanding age-dependent expressive abilities, often with the help of nurses and "play supervisors," can increase the physician's effectiveness in gaining the child's cooperation and in interpreting for the parents the new behaviors and their meaning in the context of hospitalization. By opening a discussion of the child's behavior, the physician not only addresses the disturbed behavior the parents have surely observed, but also allows the parents to express their own feelings about the illness. Making parents part of the team, that is, observing and interpreting the child's behavior, will help them to reacquire the important knowledge that they are needed and wanted collaborators in the medical management of the child both in the hospital and after the child returns home.

Children can feel and react even at times when they might appear uninterested or are absorbed by fear about their illness and the attendant hospital procedures. For this reason care must be taken to respect the modesty, integrity, and privacy of each child. And because children are likely to be afraid of situations they do not understand, they need to be told about their illness and its treatment in terms they can comprehend. Insincerity is a quality children quickly recognize, and deceiving a child is an abuse of trust that only serves ultimately to alienate him.

It should not be surprising if a child reacts angrily to painful procedures or is frustrated at his own lack of progress. An understanding physician views this anger as a normal reaction and should not feel threatened by it. It is the quiet and passive infant or child who may be a cause for concern. Older children, particularly, understand pain and even death and can be made unnecessarily anxious by bedside staff conversations that may be misinterpreted or misunderstood.

Both parents, but particularly a child's mother, are seen by the child uniquely, especially when the child is sick. The parents, in turn, know their child far better than those trying to help care for him. Listening to parents, carefully noting their observations, putting them at ease, and hearing out their worries even if they appear unrelated can help to provide them with the emotional resources needed to help their child. Impatience with or misunderstanding parents can impede their inclusion in the therapeutic process, particularly because parents will continue to care for the child after the illness—a point easily overlooked during the time of acute intervention.

To make their meaningful participation easier, parents need objective advice from the physician. While they should not be asked to make medical

judgments, they have a legal and ethical right to be informed of the benefits and risks of therapy and to be included in the decision-making process.

Finally, a pediatrician's responsibility to a child does not end when the child has been cured of a physical illness. It is the unique role of those who care for children to help them fulfill their potential and take their rightful place as responsible adults. This may require the pediatrician to go far beyond traditional medical intervention into the area of schools, environment, and economic circumstances in the effort to assist the child.

II. THE HOSPITALIZED PATIENT

A. Medical orders Written medical orders are the physician's instructions to the nursing staff concerning the care and treatment of the patient. They should be written clearly and accurately, with special consideration to dosage calculation and decimal points. Orders are the **legal responsibility** of the physician; each entry as well as each page (if there is more than one) should be correctly labeled with the time and date and properly signed. An incorrect entry should be canceled by drawing a single line through it, and *error* should be written nearby, so that there will be no confusion at a later time. Unusual orders should be discussed with the nurse at the time they are written and individualized for each patient. Properly written orders should cover diagnosis and treatment and provide for the patient's comfort and dignity. The following schemes may be utilized:

1. **Diagnosis** List the diagnostic findings in order of significance. Indicate the condition of the patient, whether critical, fair, or satisfactory. When a patient's condition is listed as critical, the family should be informed **by the physician** to avoid misunderstanding.
2. **Disposition** This includes the frequency of monitoring vital signs and weighing the patient, permitted activities, special observations, isolation procedures, and environmental conditions.
 - a. Unnecessarily frequent determination of vital signs overburdens the nursing staff and may unnecessarily discomfit the patient.
 - b. Bed rest for an ill child is often more constraining than limited activity, and the social environment will also affect the degree of activity. Hospitalized children, particularly those in isolation, should not be denied social interaction.
3. **Diet** Choose the diet with the following considerations in mind: age, caloric needs, ability to chew, and special nutritional requirements necessitated by problems of absorption, intestinal irritation, residue, and transit time (see Chap. 11).
4. **Diagnostic tests** Group in logical sequence (e.g., blood, radiographic). List all tests and the dates they are to be done. Diagnostic tests should be ordered after careful consideration of the costs, risks, and potential benefits, particularly regarding therapeutic implications.
5. **Drugs** Include generic name, dose, route, frequency, and length of time to be administered. Review orders for narcotics *daily*. In general, separate drugs for specific therapy from drugs for symptomatic relief. Orders for respiratory or physical therapy must also be explicit as to duration, frequency, type, anatomic site of administration, and associated medication. Oxygen and aerosols require specific orders as well.

B. Common pediatric procedures

#1. Venipuncture and intravenous infusion

a. Indications To withdraw venous blood or for continuous administration of solutions or drugs.

b. Site Hands, feet, scalp, or jugular or antecubital veins. The femoral veins should be avoided.

c. Technique

- (1) Restrain the hands, feet, or arm with an armboard, or shave scalp aseptically.
- (2) Place a tourniquet proximal to the puncture site. A rubber band with a small adhesive tag (for release) may be placed around the forehead to distend scalp veins in infants. Palpate the vein desired.
- (3) Attach a short-beveled No. 21 or 23 scalp vein needle to a small syringe filled with sterile saline solution. If the puncture is to be used for blood collection, attach an empty syringe.
- (4) Prepare the skin with 70% alcohol. (**This does not sterilize.** To prepare a sterile area for blood culture, iodine or thimerosal [Merthiolate] must be applied, then washed with alcohol.)
- (5) Palpate the target vein with one hand and grasp the plastic "wings" of the needle with the other. Pierce the skin lightly to one side and 0.5 cm distal to the entry site. Infants' veins, especially on the scalp, are usually superficial, and a deep thrust may cause distal wall penetration and a hematoma. If venipuncture is for a blood sample only, *reverse* the direction of the thrust by the needle.
- (6) Draw back on the syringe gently to avoid collapse of the vein.
- (7) If blood returns, confirming venipuncture, *slowly* inject 1 ml of saline and observe the site for swelling. If swelling occurs, saline is infiltrating, and a new site must be selected and prepared.
- (8) If saline enters the vein smoothly, tape the wings of the needle securely to the skin and attach the infusion set.
- (9) Protect the infusion from accidental dislodging by taping an inverted paper cup or dish over the site with a "door" cut in one side to permit tubing to pass. Avoid using excess tape on the patient's skin. Do not cover the needle site closely, since covering may delay recognition of infiltration or phlebitis.

2. Arterial puncture

a. Indications Oxygen concentration determination; blood culture in endocarditis if venous blood cultures are negative; in cases of venous collapse or extreme difficulty in obtaining venous blood.

b. Sites Femoral, brachial, temporal, or radial artery.

c. Technique

- (1) Prepare the skin with iodine solution, as described in 4.c.
- (2) No tourniquet is used.

- (3) A 23- or 25-gauge straight or butterfly needle filled with heparin and a syringe rinsed with heparin are used.
- (4) Locate the vessel by palpation.
- (5) Infiltration with 1% xylocaine (Lidocaine) is optional, but may obscure the vessel.
- (6) Puncture the skin and push the needle *through* the arterial site. Withdraw it slowly until blood is seen in the tubing.
- (7) Blood will flow into a glass syringe without suction if the artery is punctured, or pulsations may be seen in tubing if a plastic syringe and scalp vein needle are used. Allow the blood to push all visible heparin solution out into the tubing before attaching the syringe (see d).
- (8) After the needle is withdrawn, maintain compression at the puncture site for 3–5 min.

d. Cautions

- (1) If you are drawing arterial blood gases, bear in mind that even small volumes of heparin (0.2 ml) may falsely lower pH, PCO_2 , and HCO_3^- when small volumes of arterial blood (1 ml) are used. A 3-ml plastic syringe and butterfly scalp vein needle have a combined dead space of 0.41 ml.
- (2) When drawing blood cultures, remove iodine from the skin to prevent vein irritation, and swab iodine from the tops of culture bottles before inserting needle to avoid sterilization of cultures.

3. Gastric gavage

a. **Indications** When infants with normal GI function are slow to accept or cannot accept oral feeding.

b. **Site** Preferably the nasal route.

c. Technique

- (1) Wrap the child.
- (2) Insert a lubricated, cooled, 10–14F feeding catheter into either nostril along the floor of the nares, aiming at the level of the earlobes, and pass into the stomach. Estimate the length of tubing required by the distance from the nose to the ear plus the distance from the ear to the xiphoid process. Handle the tube with sterile gloves.
- (3) Observe the patient's respiration. If the trachea is entered, coughing will usually occur.
- (4) Inject 2–3 ml of air and listen over the stomach for an air rumble.
- (5) Attach the funnel and pour the feeding *slowly*.
- (6) Pinch the tube while withdrawing to avoid aspiration.

4. Lumbar puncture

a. **Indications** Diagnostic evaluation of spinal fluid or as a route for therapy. Fundoscopic examination for evidence of increased intracranial pressure is a prerequisite.

b. **Site** The 3rd or 4th lumbar interspace (at the level of the iliac crest in infants).

c. Technique

- (1) Have an assistant hold the child in the lateral recumbent position on a flat table with one arm around the back of the child's neck and the other arm in the back of the knees. The child's head should be to the left of a right-handed physician. Children, especially neonates, may also be restrained sitting on the table. *The success of the pediatric lumbar puncture depends largely on the technique of holding.*
- (2) Scrub the hands and wear surgical gloves and mask.
- (3) Prepare the back with iodine solution and wash with alcohol; **residual iodine can cause dermatitis.** Move swabs in a widening spiral away from the site to avoid contamination. Do not cross an area already scrubbed with the same swab.
- (4) Drape the area with sterile towels.
- (5) In older children, infiltrate to the dura with a 1% xylocaine solution without epinephrine.
- (6) A 20- or 21-gauge needle with a stylet is used in children. A 22- or 23-gauge needle (short) may be used in infants.
- (7) Placing your finger or thumb on the 3rd or 4th lumbar vertebra, insert the needle below the vertebral spine in the midline, aiming for the umbilicus.
- (8) A soft click is usually felt as the dura is entered.
- (9) Remove the stylet to watch for fluid.
- (10) If blood returns in the needle, replace the stylet and *leave the needle in place.*
- (11) Repeat the procedure one interspace above, but no higher.

5. Thoracentesis See also Chaps. 5 and 20.

- a. **Indications** Diagnostic evaluation of pulmonary diseases with pleural effusion; occasionally therapeutic in patients with empyema; to instill irritant chemicals in patients with recurrent pneumothorax who are not candidates for pleurectomy.
- b. **Site** In free pleural effusion, the 7th posterolateral intercostal space. If effusion is loculated, fluoroscopy or ultrasound should be utilized to locate the site of puncture.

c. Technique

- (1) Always try to have the current chest x-ray in the treatment room, and recheck the physical findings (especially dullness to percussion) to assure that the puncture site is correct.
- (2) Explain the procedure to patients who are old enough.
- (3) Have an assistant hold the patient so that the most dependent site to be tapped is easily accessible to the instruments. The best position is usually sitting upright. The patient who is under traction or in decubitus for other reasons can be positioned on two chairs or on small tables, with the chest area exposed between the chairs. The patient who is in a sitting position and is old enough can rest the head and arms on a pillow placed on top of a bedside table raised to the proper height.

- (4) Prepare the skin as in 4.c.
- (5) Palpate the ribs and count with the index and middle finger.
- (6) In older children, infiltrate the parietal pleura with 2% xylocaine (Lidocaine).
- (7) Place a hemostat or Kelly clamp across the needle approximately 1 cm from the tip, so that the needle will not inadvertently be thrust too far into the lung parenchyma.
- (8) Insert the needle (20 gauge or preferably 18), connected to a three-way stopcock and sterile syringe over the upper edge of the lower rib (to avoid the intercostal vessels).
- (9) In the majority of patients with fluid in abundance and some degree of pleural inflammation, there is a feeling of "going through leather." If a syringe is attached, a gentle pull of the plunger will aspirate fluid into the barrel.
- (10) Use of the three-way stopcock will help to facilitate removal of aliquots of fluid and to prevent air leaks while changing syringes. If the fluid is clear, a new syringe is rapidly substituted for the syringe in use until enough material is withdrawn for diagnostic tests or until the area is "dry." This maneuver of rapidly utilizing clear fluid will avoid interference with the differential diagnosis encountered in cases of "bloody" tap, since it is at the end of the procedure that trauma to the lung tissue is most likely. Remember that many effusions will be rapidly replaced by fluid from the intravascular compartment. **As a rule, remove no more fluid than the volume of blood a child can tolerate losing.**
- (11) With the child in maximal inspiration, remove the needle while maintaining negative pressure on the syringe. A plain bandage will suffice.
- (12) Check the vital signs, and if they are satisfactory, take a control chest x-ray film to detect the presence or absence of pneumothorax and associated parenchymal disease, previously obscured by fluid.
- (13) **Complications**
 - (a) **Intercostal vessel bleeding** usually is not significant unless biopsy needles are used. Its occurrence should be followed with observations of vital signs every 15 min for the next 2 hr and then hourly.
 - (b) **Pneumothorax** See Chaps. 5, Sec. IC, and 20, Sec. VII.
 - (c) **Air embolism** rarely occurs with thoracentesis, but could occur with the accidental aspiration of lung "juice."

C. Analgesia and sedation

1. Analgesia

- a. **General principles** The following guidelines may be helpful (see also Table 1-1):

- (1) If pain is present in multiple sites, only the *single* most severe source will be recognized by the patient.
- (2) Although it is sometimes assumed that pain is not felt in children,

particularly in small infants, or is easily forgotten, local anesthesia should be provided for diagnostic procedures whenever feasible.

- (3) True analgesics such as morphine may mask pain, while sedatives such as phenobarbital will not. For this reason, sedatives may be helpful in elucidating pain and tenderness, particularly in the acutely disturbed abdomen.
- (4) Postoperative pain, although generally of shorter duration in children than in adults, may still be severe enough to require medication for several days.
- (5) Neonates also feel pain, but are less able to express it. Do not forget to order analgesia for neonates when pain is expected to be present. When not otherwise contraindicated, pain relief can be achieved with smaller amounts of narcotics when combined with a sedative ("lytic cocktail," 3, p. 12).

b. Specific therapeutics

(1) Nonnarcotic analgesics See Table 1-1.

(a) **Acetylsalicylic acid (aspirin)** is the most frequently used analgesic and has antipyretic properties as well (see Sec. 2.c, p. 22, for the dose and route of administration).

i. Its analgesic properties are most suitable for the pain of headache, arthralgia, dysmenorrhea, or muscular ache. Doses in patients with acute rheumatic fever and juvenile rheumatoid arthritis are considerably higher (see Chap. 18, Sec. 1.A.3) than for simpler analgesia.

ii. Enteric-coated preparations are available to reduce gastric irritation, but absorption of these preparations is variable.

Table 1-1 Narcotic and Nonnarcotic Analgesics and Dosages for Pediatric Use

Name	Dose
Nonnarcotic:	
Acetylsalicylic acid (aspirin)	65–100 mg/kg/24 hr in 4–6 doses
Acetaminophen (Tempra, Tylenol)	Under 1 year 60 mg
	1–3 years 60–120 mg
	3–6 years 120 mg
	Over 6 years 240 mg
Propoxyphene (Darvon)	32–65 mg q3–4h prn
Pentazocine (Talwin)	30 mg q3–4h prn in adults. Not for children under 12
Narcotic:	
Codeine phosphate	3 mg/kg/24 hr in 6–8 divided doses. Anti-tussive: 1 mg/kg/24 hr
Meperidine (Dermerol)	6 mg/kg/24 hr
Methadone	0.7 mg/kg/24 hr
Morphine sulfate	0.1–0.2 mg/kg/dose
Camphorated opium tincture (Paregoric)	0.25–0.5 ml/kg/dose

iii. **Toxic effects** include salicylism (see Chap. 3, Sec. II.D), GI bleeding, iron deficiency anemia, abnormal clotting, altered thyroid function, decreased fasting blood sugar in diabetes, and increased cardiac load, which can aggravate incipient congestive heart failure and hemolysis in patients with glucose 6-phosphate dehydrogenase (G-6-PD) deficiency.

(b) **Acetaminophen (Tempa, Tylenol)** Although this drug is more valuable for antipyresis than for analgesia, its advantage is its availability in liquid form. It is also more expensive. Peak blood levels are achieved in 2 hr (see Sec. III.B.2.c). **Toxic effects** include methemoglobinemia, anemia, and liver damage, but it does not cause hemodialysis in G-6-PD deficiency. Overdose can produce fulminant liver failure. **Phenacetin**, a sister drug, has similar properties, although it is probably more toxic. It is often used with aspirin and caffeine (Empirin Compound), but there is no evidence that this combination is more effective than aspirin alone.

(c) **Propoxyphene (Darvon)** is similar to codeine. Controlled trials place it as *less* effective than aspirin, with occasional patients finding it more effective. **Toxic reactions** include GI upset, vertigo, and drowsiness, as well as pruritus and skin eruptions. Severe reactions include cyanosis, convulsions, coma, and respiratory depression. **It is not approved for use in children under 12.** Overdose is potentially lethal. If safer alternatives are available, propoxyphene should probably not be available at all in homes where small children reside.

(d) **Pentazocine (Talwin)**, a morphine-related drug, produces weak morphine antagonism and morphinelike subjective effects. **It is not approved for use in children under 12**, and because of its adverse effects on the CNS, **its use should be reserved for hospitalized patients.** For an extensive discussion of this preparation, see *Med. Lett. Drugs Ther.* 18:45, 1976.

(2) **Narcotic analgesics** See Table 1-1.

(a) **Codeine**, a morphine derivative, is more effective than aspirin but less so than morphine itself. It is also less addictive than morphine and causes less disturbance of GI function, although seizures have been reported with its use. Its antitussive properties are well known, and it is frequently used for this purpose; however, there is risk of its abuse for this indication. Prolonged use of any narcotic is constipating. This may be especially significant postoperatively.

(b) **Meperidine (Demerol)** is probably a more effective analgesic than codeine, partly because higher doses are tolerated. It is highly addictive but less constipating and less depressing to the respiratory center than is morphine. It is widely used as an obstetric analgesic. *Because it does not constrict smooth muscle*, meperidine can be used in the presence of asthma, although sedation in any case of respiratory distress is extremely dangerous.

In combination with promethazine (Phenergan) and chlorpromazine (Thorazine), it can be used as a "lytic cocktail" to produce rapid sedation with analgesia for painful diagnostic procedures (see Table 1-1 and 3, p. 12).

(c) Methadone is included because of its widespread use in anti-addiction programs and in cancer patients with ongoing severe pain. Its analgesic potency is roughly equivalent to that of morphine, and it is effective PO. Its respiratory depressant effect is considerable, but it causes less GI disturbance than does morphine. When an addict can substitute it for morphine or heroin, withdrawal may ultimately be eased, if more prolonged. Nevertheless, **methadone is addictive**. It merely produces less euphoria than morphine or heroin; thus, the psychological component of addiction is undermined by its use.

(d) Morphine is perhaps the most important and widely used narcotic analgesic and is effective in any age group. It has little sedative effect and produces concomitant euphoria, with the risk of addiction.

i. Because PO and PR preparations, although effective, are somewhat unreliable in absorption and metabolism, parenteral use is generally advised, either SQ (20 min), IM (20 min), or IV (immediate but dangerous). Analgesia usually lasts 3–4 hr.

ii. Morphine is excreted via the liver and **should be administered with caution to a newborn or a patient with liver disease**.

iii. **Paregoric or camphorated opium tincture** makes use of the constipating properties of morphine to aid in relieving symptoms of diarrhea with spasm of the colon. **Camphorated opium tincture should never be confused with tincture of opium, which is 25 times more powerful.**

iv. Because morphine is so addictive, its administration in the pediatric age group should be limited to patients with pulmonary stenosis and infundibular spasm, congestive heart failure, severe visceral pain of known origin, intractable pain, severe postoperative pain, and the pain of terminal disease. Although up to 14 days of administration is usually required to produce addiction, some adolescents may become addicted on only 1 or 2 doses.

v. **Tolerance to morphine** includes tolerance to its CNS depressive properties, so that increasing the dose does not increase the likelihood of respiratory toxicity. The physician should remember that when a patient's dose is missed, an amount smaller than normal may suffice at the next dose. Death frequently occurs in addicts who administer *their usual high dose* after a few days off the drug, when tolerance is less.

vi. **Toxic effects** include respiratory depression, increased intracranial pressure, arterial hypotension, nausea and vomiting, hyperglycemia, antidiuresis, urinary retention, addiction, and constipation.

vii. A unique problem is the treatment of newborn infants of morphine-addicted mothers. Chlorpromazine, 0.7–1.0 mg/kg q6h IM, and paregoric, 2–4 gtt/kg q4h, have been used effectively to prevent withdrawal symptoms in these infants [see 3.b(2), p. 144].