

# THE FEBRILE CHILD

Clinical Management  
of Fever  
and Other Types  
of Pyrexia

MARTIN I. LORIN

# THE FEBRILE CHILD

---

## Clinical Management of Fever and Other Types of Pyrexia

MARTIN I. LORIN, M.D.

Associate Professor of Pediatrics  
Director, House Staff Education  
Department of Pediatrics  
Baylor College of Medicine  
Attending Physician  
Texas Children's Hospital  
and Harris County Hospital District  
Houston, Texas



A WILEY MEDICAL PUBLICATION  
**JOHN WILEY & SONS**

New York · Chichester · Brisbane · Toronto · Singapore

*Cover design by Wanda Lubelska  
Production Editor: Cheryl Howell*

Copyright © 1982 by John Wiley & Sons, Inc.

All rights reserved. Published simultaneously in Canada.

Reproduction or translation of any part of this work beyond that permitted by Sections 107 or 108 of the 1976 United States Copyright Act without the permission of the copyright owner is unlawful. Requests for permission or further information should be addressed to the Permissions Department, John Wiley & Sons, Inc.

**Library of Congress Cataloging in Publication Data:**

Lorin, Martin I.

The febrile child.

(A Wiley medical publication)

Includes bibliographical references and index.

1. Fever in children. 2. Fever in children—Treatment.

I. Title. II. Series. [DNLM: 1. Fever—Therapy.

2. Fever—In infancy and childhood. WB 152 L872f]

RJ520.F47L67 1982 618.92'0047 82-8550

ISBN 0-471-08329-1

AACR2

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

*To that unsung hero—the pediatric chief resident*

# Preface

---

Few clinical textbooks dealing with the important topic of fever have been published in recent decades, and not one has been devoted to the problem in the pediatric patient. This book is intended to remedy that situation. It is hoped that a broad audience of students and practitioners will find it clear and practical enough to be readable as a monograph, yet detailed enough to be serviceable as a reference. The advantage of a single author has permitted an integrated text with a unified approach and consistent style. Nevertheless, every attempt has been made to present all sides of each argument and controversy. Repetition has been held to a minimum—just enough to permit each chapter to be used separately should the reader so choose.

I would like to express my appreciation to colleagues who reviewed parts of the manuscript: Ralph D. Feigin, Zvi Friedman, Marvin Fishman, Sheldon Kaplan, Marilyn Lemos, William Shearer, and Thomas A. Vargo. Acknowledgments are due my wife, Nadira, who not only provided the line drawings and figures, but also encouragement and support. A very special note of thanks goes to Sharon Williams, who proofread, typed, and retyped the text, and who calmly and kindly accepted each new revision even though the previous one had been promised to be the last. I am deeply grateful again to Dr. Ralph D. Feigin, Chairman of Pediatrics at Baylor College of Medicine, for providing the academic milieu in which a work such as this could be developed and brought to fruition.

MARTIN I. LORIN

# Contents

---

## **PART 1 PATHOPHYSIOLOGY**

---

### **1. Fever and Other Elevated Body Temperatures 3**

Temperature Elevation 3

Clinical Examples 4

Clinical Management of Elevated Temperature 6

Fever as a Sign or Symptom 6

References 7

### **2. Temperature Regulation and Homeothermy 8**

Homeothermy 8

Central Control of Body Temperature 9

Noncentral Control of Body Temperature 13

Normal Body Temperature 14

Limits of Normality 17

References 17

### **3. Pathophysiology of Fever 19**

Fever: A Thermoregulation Rise in Body Temperature 19

Mechanism of Fever Production 21

An Upper Limit to Fever 24

Defervescence 24

Patterns of Fever 24

References 25

**4. Fever: Friend or Foe 27**

Arguments Against the Symptomatic Treatment of Fever 27

Arguments for the Symptomatic Treatment of Fever 31

To Treat or Not to Treat 37

References 38

---

**PART 2 CLINICAL RELEVANCE**

**5. Clinical Measurement of Body Temperature 43**

Site of Temperature Measurement 43

Thermometer Types 45

Parents' Assessment of Temperature 47

References 48

**6. Fever of Recent Onset 49**

Differential Diagnosis of Fever of Recent Onset 49

Clinical Relevance of the Height of the Fever 54

Clinical Relevance of the Age of the Patient 59

Clinical Signs of Serious Infection, Including Bacteremia 62

References 66

**7. Fever Without Localizing Signs 69**

Incidence 69

Differential Diagnosis 70

Occult Bacteremia 73

Laboratory Tests to Detect Bacteremia and Other Bacterial Diseases 76

Outcome in Patients with Unsuspected Bacteremia 82

Clinical Management of the Febrile Child Without Localizing Signs 84

References 91

**8. Fever of Undetermined Origin 94**

Definition 94

Incidence	96
Differential Diagnosis	96
Infectious Causes of FUO	97
Noninfectious Causes of FUO	105
Clinical Clues to the Diagnosis of FUO	108
Laboratory Studies	111
Clinical Approach to the Child with FUO	114
Outcome and Prognosis	116
References	117

## **9. Fever in the Abnormal Host 119**

The Newborn	119
The Child with Cancer	122
The Immunodeficient Child	124
The Malnourished Child	126
Neurologic Disorders	126
References	128

## **10. Fever in the Critically Ill Child 130**

Primary Causes of Fever in the Critically Ill Child	130
Secondary Causes of Fever in the Critically Ill Child	132
Factors Contributing to Fever or Hyperpyrexia	135
Consequences of Fever in the Critically Ill Patient	136
Influence of Fever or Hyperthermia on Physiologic Parameters	140
Treatment of Fever in the Critically Ill Child	141
References	144

## **11. Fever Due to Drugs, Toxins, and Poisons 146**

Fever Secondary to Drug Reactions	146
Fever Due to Toxins and Poisons	150
References	151



**12. Febrile Convulsions 153**

- Convulsions in Association with Fever 153
- Simple Versus Complex Febrile Convulsions 157
- Effects and Outcome of Febrile Convulsions 160
- Risk Factors for Subsequent Development of Afebrile Seizures (Epilepsy) 163
- The Risk of Recurrences of Febrile Convulsions 165
- Diagnostic Evaluation of Patients with Febrile Convulsions 166
- Prevention of Recurrences of Febrile Seizures 170
- References 177

**13. Heat Illness 181**

- Heat Cramps 181
- Heat Exhaustion 182
- Heat Stroke 182
- Malignant Hyperthermia 191
- References 195

**PART 3 SYMPTOMATIC THERAPY**

---

**14. Rational Symptomatic Therapy of Fever and Other Elevations of Body Temperature 197**

- Treatment of Fever 199
- Treatment of Central Nervous System Fever 203
- Treatment of Heat Illness 203
- References 204

**15. Antipyretic and Hypothermic Drugs 205**

- Pharmacology of Aspirin and Acetaminophen 205
- Toxic Effects of Aspirin 209
- Toxic Effects of Acetaminophen 218
- Other Antipyretic Agents 222
- Choice of an Antipyretic Agent 223
- Combined Use of Aspirin and Acetaminophen 226

Hypothermic Agents 227

References 228

**16. Physical Cooling 234**

Indications for Physical Cooling 234

Tepid Sponging 236

Ice Cooling 237

Use of the Cooling Mattress 238

Other Means of Mechanical Cooling 239

References 240

**Index 241**

Part 1

---

# **PATHOPHYSIOLOGY**



# 1

## FEVER AND OTHER ELEVATED BODY TEMPERATURES

---

### TEMPERATURE ELEVATION

It is best, at the very onset, to clarify the distinction between fever and other types of body temperature elevation (Table 1-1). Fever refers to that condition in which the body *thermoregulates* an increase in core temperature as an organized and coordinated response to a disease or other insult. Conditions in which core temperature rises *despite* the body's attempt to maintain euthermia (for example, in cases of heat stroke, malignant hyperthermia, or atropine poisoning) should be referred to as hyperthermia rather than fever. This distinction will be explored more fully in Chapters 3 and 13. All temperature elevation is not necessarily pathologic. Under certain circumstances, an increased body temperature is not abnormal and should not be viewed as disease. For example, core temperature varies with time of day, physical activity, environmental temperature, food intake, and emotional state.

Fever is probably the most frequent, and certainly one of the most important, manifestations of disease in children. It accounts for up to one-third of all office visits to the pediatrician, an even greater percentage of after-hours emergency visits, and innumerable telephone calls (1,2). In a prospective survey of nine pediatricians in private practice in New York State, 10% of all office visits of patients younger than 2 years of age were associated with a temperature of 101 F (38.3 C) or greater (3).

Fever is a symptom that no child escapes experiencing, few parents face without concern, and hardly a pediatrician goes a day in practice without encountering. Fever is seen in previously healthy children as well as in children with chronic illnesses. It is a frequent problem both in hospitalized

**Table 1-1.** Classification of Body Temperature Elevation

<i>Type</i>	<i>Mechanism</i>	<i>Examples</i>
Fever	Body <i>regulates</i> itself to a higher than normal temperature	Infection Connective tissue disease Cancer
Heat illness	Imbalance between heat production and heat dissipation results in elevated temperature <i>despite</i> body's attempt to maintain normal temperature	Heat stroke Hyperthyroidism Atropine poisoning
Normal variation	Increase in body temperature related to <i>normal</i> activities or physiologic processes	Circadian rhythm Exercise Postprandial

patients and in out-patients. It may be a sign of trivial illness or of lethal disease. Fever afflicts all ages, both sexes, all races, and the rich and poor alike. It is a problem for all seasons and for all physicians.

Since it is so common, most physicians assume that they are knowledgeable about temperature elevation and expert in its management. Yet, it is surprising how little time in medical school is assigned to this common and important topic. Most medical school curricula relegate the pathophysiology and treatment of fever to brief sections in physiology and pharmacology, respectively, and fail to reexamine these topics as distinct entities during the clinical years. There is generally little discussion of the differences between fever and other types of elevated body temperature. Postgraduate training usually neglects fever even more, viewing it only as a sign or symptom and ignoring its importance as a pathophysiologic state. With few exceptions, most standard textbooks of pediatrics do not have a section devoted to fever, and almost all fail to discuss temperature regulation or the rational symptomatic management of an elevated body temperature. Thus, the clinician may be misled into a false sense of security and a dangerous attitude of complacency when dealing with the febrile or hyperthermic patient.

## CLINICAL EXAMPLES

To appreciate the varied and challenging problems associated with an elevation of body temperature, the reader is invited to consider the following cases. These clinical vignettes illustrate the complexity of decision making, which all too often is taken for granted.

A 2½-year-old child with a past history of febrile convulsions presents to the pediatric emergency room with a temperature of 104.4 F (40.3 C) and a

middle ear infection. He has not been receiving anticonvulsant medications. In addition to therapy for otitis media, should you also prescribe aspirin, acetaminophen, sponging, or a combination of two, or perhaps all three, of these? Are the effects of these different agents additive, synergistic, or neither?

A patient with meningitis and clinical features of septic shock has a high fever. Should you attempt to reduce the fever? If so, by what means and how vigorously? Will restoration of body temperature to normal increase or decrease the chances of survival? Will it affect the outcome in regard to recovery of cerebral function?

A toddler with severe aspirin poisoning has a body temperature of 105 F (40.6 C). Would it be appropriate to treat the child with acetaminophen? Cold sponging? Both? Neither?

An infant who had been left in an automobile parked in the sun is brought to the emergency room where he is found to have a rectal temperature of 108 F (42.2 C). The child is unresponsive. His skin is hot and dry. Would the more appropriate therapy be to sponge the patient with tepid water or to immerse him in ice water? Should aspirin or acetaminophen be administered? What else needs to be done?

Three children present to a pediatrician's office. All are between 1 and 2 years of age. The first child has a temperature of 106 F (41.1 C), the second, 104 F (40 C) and the third, 101 F (38.3 C). Does the child with the temperature of 106 F (41.1 C) have a statistically greater chance of being bacteremic or of harboring a serious bacterial infection than the child with the temperature of 104 F (40 C)? Is the youngster with the fever to 104 F (40 C) more likely to be seriously ill or bacteremic than the child with fever to 101 F (38.3 C)?

An athletic adolescent moves from a northern city to a hot and humid southern city. He finds that his body temperature rises to 102 F (38.9 C) when he jogs five miles or more. Is this abnormal? Would aspirin taken prior to running help him maintain a normal body temperature and feel more comfortable?

Although some of the situations described above are less serious than others, the wrong decision could adversely affect the outcome in all cases. The answers to questions such as these require more than an empirical approach to the management of an elevated body temperature. They require an understanding of temperature regulation and of the pathophysiology of temperature elevation and fever. They require knowledge of the causes of fever and other elevations of body temperature, information about the significance of fever and the magnitude of the febrile response, and awareness of the biologic effects of fever and hyperpyrexia. Although there is still a great deal to be learned about when fever is beneficial and when it is harmful, sufficient data are available to permit the physician to distinguish between a correct and incorrect response in all of the above cases.

## CLINICAL MANAGEMENT OF ELEVATED TEMPERATURE

Fever has major physiologic effects, some of which may influence the course of a disease favorably or unfavorably. Fever can be treated symptomatically quite effectively, and most of the agents and modalities employed are available to the patient or parent without a physician's prescription. However, it should be recognized that each of the drugs and physical measures used to combat fever carries its own set of risks and side effects, and that these are neither rare nor inconsequential.

Faced with a child with an elevated temperature, the physician must concern himself with symptomatic treatment as well as with the search for a specific etiology. The following questions need to be addressed.

What is the mechanism of the temperature elevation? That is, is it fever or a form of heat illness?

What is the specific etiology?

Should the elevated temperature be treated symptomatically? In other words, should treatment be aimed at the fever itself, in addition to the underlying disease?

If the elevated body temperature is to be treated symptomatically, how can this best be accomplished? What pharmacologic agents and what physical means are available to help restore body temperature to normal? What are the side effects of the agents or the physical modalities used to reduce an elevated body temperature, and how can one avoid these side effects?

## FEVER AS A SIGN OR SYMPTOM

The importance of fever as a *sign or symptom* transcends the fact that it is so common. There are other considerations that make an elevated body temperature significant and noteworthy.

*As an indicator of disease, fever is often the first or sole finding.* It may be the only sign or symptom that alerts the child, parent, or physician to the presence of a serious illness. In some cases, disappearance of fever may be the first change to herald clinical improvement or resolution of a pathologic process. In other cases, fever may be the very last finding to resolve, and persistent elevation of temperature may be the only indication of continued disease activity.

*Fever can be detected and verified quickly and accurately.* Few other manifestations of disease are so readily recognized and objectively documented as fever. This can be accomplished easily by lay persons as well as by health professionals.

*Fever is easily and accurately quantitated,* unlike most other complaints, such as pain, malaise, weakness, and fatigue. Furthermore, this quantitation



may be performed by the parent (or adolescent patient) as easily as by the nurse or physician.

*Fever generally arouses concern and anxiety in both the patient and his family.* Because it is so readily detected and quantitated, and because of lay attitudes based on both fact and fiction, fever can be very frightening and disturbing. Schmitt (4) reported that about half of the parents attending a hospital-based pediatric clinic believed that a temperature of 104 F (40 C) could cause permanent neurologic damage, and the majority of the parents acknowledged that they worried about possible harmful effects of fever. He labeled such misconceptions "fever phobia."

## REFERENCES

1. Giesel LO: Fever control in the office and home. *Pediatr Clin North Am* 8:73, 1961.
2. Strasser PH, Levy JC, Lamb GA, Rosenkrans J: Controlled trial of pediatric telephone protocols. *Pediatrics* 64:553, 1979.
3. Hoekelman R, Lewin EB, Shapira MB, et al: Potential bacteremia in pediatric practice. *Am J Dis Child* 133:1017, 1979.
4. Schmitt BD: Fever phobia: Misconceptions of parents about fever. *Am J Dis Child* 134:176, 1980.