

# **Modern Management of High-Risk Pregnancy**

**Edited by  
Niels H. Lauersen**

# **Modern Management of High-Risk Pregnancy**

**Edited by**

**Niels H. Lauersen**

*Mount Sinai School of Medicine  
New York, New York*

**With a Foreword by Frederick P. Zuspan**

**Plenum Medical Book Company  
New York and London**

---

Library of Congress Cataloging in Publication Data

Main entry under title:

Modern management of high-risk pregnancy.

1. Pregnancy, Complications of. I. Lauersen, Niels. [DNLM: 1. Perinatology. 2. Pregnancy complications. WQ 240 P957]

RG571.P678 1983

618.3

83-11127

ISBN 0-306-41306-X

---

© 1983 Plenum Publishing Corporation  
233 Spring Street, New York, N.Y. 10013

Plenum Medical Book Company is an imprint of Plenum Publishing Corporation

All rights reserved

No part of this book may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording, or otherwise, without written permission from the Publisher

Printed in the United States of America

# Contributors

**Garland D. Anderson, M.D.**  
Associate Professor and Director  
Division of Maternal/Fetal Medicine  
Department of Obstetrics and Gynecology  
The University of Tennessee College of  
Medicine  
Memphis, Tennessee 38163

**Stuart Campbell, M.D.**  
Professor of Obstetrics and Gynaecology  
King's College Hospital Medical School  
University of London  
London, SE5 9RS England

**Lars L. Cederqvist, M.D.**  
Associate Professor Obstetrics and  
Gynecology  
The New York Hospital-Cornell Medical  
Center  
New York, New York 10021

**T. Chard, M.D.**  
Professor

**Departments of Reproductive Physiology  
and Obstetrics and Gynaecology**  
St. Bartholomew's Hospital Medical  
College  
The London Hospital Medical College  
London, EC1A 7BE England

**M. Yusoff Dawood, M.D. (Sheffield),  
M.M.D. (Singapore), M.R.C.O.G.**  
Professor of Obstetrics and Gynecology  
Director of Division of Reproductive  
Endocrinology  
Department of Obstetrics and Gynecology  
University of Illinois College of Medicine  
Chicago, Illinois 60612

**Harold E. Fox, M.D.**  
Associate Professor of Obstetrics and  
Gynecology  
Medical Director, Western and Upper  
Manhattan Perinatal Network  
College of Physicians and Surgeons  
Columbia-Presbyterian Medical Center  
New York, New York 10032

Fritz Fuchs, M.D.  
Professor of Obstetrics and Gynecology  
The New York Hospital-Cornell Medical  
Center  
New York, New York 10021

Robert C. Goodlin, M.D.  
Professor of Obstetrics and Gynecology  
The University of Nebraska Medical  
Center  
College of Medicine  
Omaha, Nebraska 68105

Howard M. Hochberg, M.D.  
Vice President  
Squibb Medical Systems Group  
Bellevue, Washington 98008

Peter Husslein, M.D.  
Assistant Professor  
Department of Obstetrics and Gynecology  
I. Universitäts-Frauenklinik  
Vienna University  
Vienna, A-1090 Austria

Lois Jovanovic, M.D.  
Assistant Professor of Medicine  
Department of Medicine, Metabolism  
The New York Hospital-Cornell Medical  
Center  
New York, New York 10021

Firyal S. Khan-Dawood, Ph.D. (London)  
Associate Professor of Obstetrics and  
Gynecology  
Department of Obstetrics and Gynecology  
University of Illinois College of Medicine  
Chicago, Illinois 60612

Niels H. Lauersen, M.D.  
Associate Professor of Obstetrics and  
Gynecology

Division of Perinatology  
Mount Sinai School of Medicine  
New York, New York 10029

Judith Lumley, Ph.D.  
Senior Lecturer  
Department of Obstetrics and  
Gynaecology  
Monash University  
Queen Victoria Medical Centre  
Melbourne 3000, Australia

F. A. Manning, M.D., M.Sc. (OXON),  
F.R.C.S. (C)  
Professor of Obstetrics and Gynecology  
Division of Maternal Fetal Medicine  
Department of Obstetrics, Gynecology,  
and Reproductive Sciences  
University of Manitoba  
Winnipeg, Manitoba R3E 0W3, Canada

I. Morrison, M.B., Ch.B, F.R.C.S. (C)  
Associate Professor of Obstetrics and  
Gynecology  
Division of Maternal Fetal Medicine  
Department of Obstetrics, Gynecology,  
and Reproductive Sciences  
University of Manitoba  
Winnipeg, Manitoba R3E 0W3, Canada

Yuji Murata, M.D.  
Professor of Obstetrics and Gynecology  
Department of Obstetrics and Gynecology  
University of California Irvine Medical  
Center  
Orange, California 92668

J. Malcolm Pearce—  
Lecturer, Department of Obstetrics and  
Gynaecology  
King's College Hospital Medical School

University of London  
London SE5 9RS, England

Charles M. Peterson, M.D.  
Associate Professor of Medicine  
The Rockefeller University  
New York, New York 10021

Peter Renou, MB., B.S., F.R.A.C.O.G.,  
M.R.C.O.G.  
Senior Lecturer  
Department of Obstetrics and  
Gynaecology  
Monash University  
Queen Victoria Medical Centre  
Melbourne 3000, Australia

Eliahu Sadovsky, M.D.  
Professor of Obstetrics and Gynecology  
Hadassah University Hospital  
Kiryat Hadassah  
Jerusalem, 91 120 Israel

Joe Leigh Simpson, M.D.  
Head, Section of Human Genetics  
Department of Obstetrics and Gynecology  
Northwestern University Medical School  
Chicago, Illinois 60611

William N. Spellacy, M.D.  
Professor and Head  
Department of Obstetrics and Gynecology  
University of Illinois College of Medicine  
Chicago, Illinois 60612

Marion S. Verp, M.D.  
Assistant Professor of Obstetrics and  
Gynecology  
Section of Human Genetics  
Department of Obstetrics and Gynecology  
Northwestern University Medical School  
Chicago, Illinois 60611

Carl Wood, M.B., B.S., F.R.C.S.,  
F.R.C.O.G., F.R.A.C.O.G.  
Professor and Chairman  
Department of Obstetrics and Gynaecology  
Monash University  
Queen Victoria Medical Centre  
Melbourne 3000, Australia

Frederick P. Zuspan, M.D.  
Professor and Chairman  
Department of Obstetrics/Gynecology  
The Ohio State University-N935  
University Hospital  
Columbus, Ohio 43210

# Foreword

This textbook identifies the major advances in our knowledge of clinical fetal health and underscores the era of scientific obstetrics during the past decade. If one were to review this table of contents and then look at a book of 10 or 15 years ago, a very dramatic change would be seen that points toward a better clinical understanding in the care of the fetus. This blending together of the obstetrician in maternal and fetal medicine and the pediatrician and neonatologist has developed a new area of interest and expertise called "perinatology." The survival rates for the small fetus have paralleled the development of these two sciences. It is now not uncommon for a baby, if it weighs more than 1250 g, to have more than a 90% chance of fetal salvage, which, if considered 15 years ago, would be unheard of.

The real question is, why have these tremendous advances taken place? The answers are contained in this textbook, because the individuals who have written these chapters are the ones who wrote the science of perinatology that has now been translated into clinical usefulness. The basis of all understanding in medicine begins with basic science, which is ultimately translated to clinical science, then to applied science, and finally to what we now call clinical care. This book embellishes all of these areas and focuses on the fetus, its health and outcome.

The authors of this text have been expertly identified by the editor, Niels Lauersen, from many areas of the world. England, the United States, and Australia are represented in this *Who's Who* lineup of chapter authors.

The readers,  
rubbing heads with

Frederick P. Zuspan, M.D.



# Preface

The purpose of the volume is to make the clinician aware of the most recent and advanced methods for managing high-risk pregnancies. An increasing number of patients are at high risk in recent years, and the practicing obstetrician needs a clinical guide that clearly references the most up-to-date treatments for all high-risk conditions. This volume contains the latest suggestions for monitoring hormonal and biophysical variations during normal and abnormal pregnancies. Included are discussions of genetic counseling, ultrasonographic monitoring of fetal growth, modern management of the diabetic patient, and nutrition during pregnancy. The book also contains chapters on the latest developments in biochemical and biophysical antenatal surveillance, the management of premature infants, and treatment of patients with premature ruptured fetal membranes. In addition, the clinician is introduced to the latest recommendations for intrapartum electronic and acid-base fetal monitoring as well as protocols for the handling of labor and delivery of the high-risk patient. This book is geared toward the practicing obstetrician. Each chapter suggests the fundamentals of modern clinical management, including the latest technology, methods of application, and a summary of current experience in the management of the high-risk patient. This book will be useful for clinicians, residents, and students as well as scientific investigators interested in high-risk patient management.

Niels H. Lauersen, M.D.

*New York*

# Acknowledgments

The editor wishes to thank many people whose enthusiasm and effort made this book a reality.

I am especially grateful to Dr. Zöe Graves, my research associate and colleague, whose organization and editing of this book helped to make it extremely clear and comprehensive.

My thanks also go to Lori Leeds, my research assistant and secretary for many years, for her excellent help in organizing the chapters and systematizing the artwork in this volume.

I also wish to acknowledge a deep indebtedness for the dedicated collaboration of Carol Shiroky, Maryellen Kurkulos, and Karyn Lewin, who helped organize and research the manuscript.

In addition, I owe thanks to Laurel P. Rand for the excellent illustrations and to Tamara Galimidi for preparation of some of the photographic materials.

I finally wish to thank Hilary Evans and her associated staff at the Plenum Publishing Corporation for their valuable assistance in the preparation of this book.

Niels H. Lauersen

# Contents

<b>1</b>	<b>The Monitoring of Hormonal Variations during Pregnancy</b>	<b>1</b>
	T. Chard	
	The Biology and Measurement of Fetoplacental Hormones	3
	Placental Products in Relation to Obstetric Pathology	7
	Placental Products in Relation to Clinical Conditions	9
	Analysis of the Clinical Results of Placental Function Tests	9
	How Useful Is a Test? Analysis of Clinical Efficiency	13
	The Design of Studies on Tests of Fetal Well-Being	15
	The Importance of Serial Determinations	16
	Conclusions	17
	References	17
<b>2</b>	<b>Monitoring and Detection of Genetic Disorders</b>	<b>19</b>
	Marion S. Verp and Joe Leigh Simpson	
	Genetic Counseling	19
	Amniocentesis	20
	Cytogenetic Studies	25
	Disorders	34
	Legal Issues	49
	Technique and Safety of Accepted Indications for Antenatal Mendelian and Polygenic	
	Future Utilization of Genetic Services	48
	References	50

### **3 Ultrasonic Monitoring of Normal and Abnormal Fetal Growth**

**57**

J. Malcolm Pearce and Stuart Campbell

Growth	57	Antenatal Measurement of Fetal Growth	67
Summary	94	References	95

### **4 Modern Monitoring and Management of the Diabetic Pregnant Patient**

**101**

Lois Jovanovic and Charles M. Peterson

Classification	102	Diabetogenic Factors of Pregnancy	104
Screening for Diabetes in Pregnancy	106	Means of	
Monitoring Blood Glucose	108	Diet Prescription	110
Insulin	111	Glycosylated Hemoglobin as a Monitor of	
Maternal Glycemic Control	114	Prevention of	
Hypoglycemia	118	Timing of Delivery	118
Treatment during Labor and Delivery	120	Postpartum	
Care	121	Relationship of Glucose Levels to Outcome of	
Pregnancy	123	Summary	123
		References	124

### **5 Monitoring of Maternal Weight Gain and Nutrition during Pregnancy**

**129**

Garland D. Anderson

Nutritional Requirements in Pregnancy	130	The Initial	
Prenatal Visit	130	Monitoring of Weight Gain in	
Pregnancy	131	Who Requires Nutritional Assessment during	
Pregnancy?	134	Nutritional Supplements and Prenatal	
Vitamins	139	Overweight Women	142
Underweight Woman	143	The	
Pregnancy	145	Poor Weight Gain during	
Patient Education	147	The Economically Deprived Woman	146
References	149	Summary	149

### **6 The Use of $\alpha$ -Fetoprotein in the Evaluation of the Fetus**

**151**

Lars L. Cederqvist

Biology of $\alpha$ -Fetoprotein	151	Screening for Neural Tube	
Defects	155	Other Fetal Conditions Associated with Elevated	

AFP Levels	165	Increased $\alpha$ -Fetoprotein Levels Associated with Breakdown in the Fetal-Maternal Barrier	173
Significance of Decreased $\alpha$ -Fetoprotein Levels	174	Summary	174
References	175		

## 7 Monitoring of Estriol during Pregnancy 185

M. Yusoff Dawood and Firyal S. Khan-Dawood

Biosynthesis of Estriol	185	Urinary Estriol	188
Plasma Estriol	189	Choice between Plasma and Urinary Estriol	191
Clinical Uses of Plasma Estriol	192	Follow-up of Infants with Low Maternal Estriol Levels	197
Amniotic Fluid Estriol in High-Risk Pregnancies	197	Estetrol (15 $\alpha$ -Hydroxyestriol)	198
Dehydroepiandrosterone Sulfate Loading Test	198	Conclusion	200
References	200		

## 8 The Use of Human Placental Lactogen in the Management of High-Risk Pregnancies 205

William N. Spellacy

Human Placental Lactogen in Normal Pregnancy	206	Human Placental Lactogen in High-Risk Pregnancies	207
Other Perinatal Monitoring Tests	209	Human Placental Lactogen as a Perinatal Assessment Screening System	212
Summary	213	References	214

## 9 History of Electronic Fetal Monitoring 217

Robert C. Goodlin

Fetal Heart Phonocardiogram	220	Abdominal Fetal ECG	220
Intrauterine Fetal ECG	221	Doppler Transducers	222
Fetal Heart Rate Deceleration	223	Beat-to-Beat Variability	225
Systolic Time Intervals	226	Electronic Monitoring of Fetal Oxygen Levels	227
Fetal Photoelectric Plethysmographic Pulse	228	The Fetal Ballistocardiograph	228
Radio Telemetry of Fetal ECG	229	Fetal Breathing	229
Fetal Electroencephalogram	230	Fetal Antenatal Monitoring	230
Nonstress Tests	231	Monitoring Uterine Activity	231

Pressure Changes	232	Conclusion	232
References	234		

## 10 Current Status of Instruments and Methods for Fetal Monitoring 237

Howard M. Hochberg

Electronic Fetal Monitoring	238	Monitoring the Fetal Heart Rate	246
Monitoring Uterine Activity	261	Other Heart Rate and Contraction Measurements Provided by Commercial Fetal Monitors	266
Telemetry—Monitoring at a Distance	268	Central Stations	271
Record Storage	273	Monitoring Fetal Activity	274
Monitoring Fetal Breathing Movements	274	Monitoring Fetal Cardiac Contractility: Systolic Time Intervals	276
Other Fetal Parameters	278	Intrapartum Maternal Monitoring	280
Computers and Microprocessors in Fetal Monitoring	280	Transcending Electronic Fetal Monitoring: New Dimensions in Technology for Fetal Care	281
Conclusion	288	References	288

## 11 Fetal Surveillance with Nonstress and Stress Tests 297

Niels H. Lauersen

Fetal Heart Rate Monitoring Techniques	299	Uterine Activity Monitoring Techniques	300
Monitoring Fetal Movement	300	Intrauterine Surveillance Using NST and OCT	301
Other Indices of Fetal Well-Being	316	Comments	318
Conclusion	320	References	321

## 12 Antepartum Monitoring of Fetal Movements 325

Eliahu Sadovsky

The Nature of Fetal Movements	326	Responses to Stimuli	331
Assessment of Fetal Movements	333	Fetal Distress and Fetal Movements	335
Fetal Movement and Tests of Respiratory Failure	341	Summary	343
References	344		

<b>13</b>	<b>Antepartum Monitoring of Fetal Breathing</b>	<b>347</b>
	I. Morrison and F. A. Manning	
	History 347 Background 348 Factors Influencing	
	Fetal Breathing Movements 350 Clinical Application 355	
	Conclusion 359 References 360	
<b>14</b>	<b>Antepartum Monitoring of the Preejection Period of the Fetal Cardiac Cycle</b>	<b>363</b>
	Yuji Murata	
	Definition of the Preejection Period 363 Method of	
	Determination of Antepartum Preejection Period of the Fetal Cardiac	
	Cycle 365 Physiology of the Preejection Period 366	
	Pathological Responses of the Preejection Period 369 The	
	PEP of Antepartum Human Fetuses 370 References 373	
<b>15</b>	<b>Prevention and Management of Prematurity</b>	<b>375</b>
	Fritz Fuchs and Peter Husslein	
	Definitions 375 Diagnosis of Preterm Labor 376	
	Mechanism of Labor 377 Principles of Tocolytic	
	Treatment 378 Choice of Appropriate Treatment 383	
	Monitoring of Advanced Preterm Labor 391 Management of	
	Preterm Delivery 392 Conclusions 393	
	References 393	
<b>16</b>	<b>Modern Management of Premature Rupture of Fetal Membranes</b>	<b>397</b>
	Niels H. Lauersen	
	Definition of Prematurely Ruptured Membranes 397	
	Incidence of PROM 398 Etiology of Prematurely Ruptured	
	Membranes 398 Diagnosis of PROM 399	
	Management of Premature Rupture of the Membranes 400	
	Fetal Risks Associated with Prematurely Ruptured Membranes 401	
	Maternal Risks Associated with PROM 402 The Management	
	of PROM at Various Gestational Ages 403 The Use of	
	Steroid Therapy in Patients with PROM 410 The Role of	
	Amniocentesis in the Management of Patients with PROM 411	

Diagnosis of Chorioamnionitis	412	Bacteriostatic Properties	
of the Amniotic Fluid	414	The Use of $\beta$ Sympathomimetics	
in Patients with PROM	415	Premature Rupture of	
Membranes and Group B $\beta$ -Hemolytic Streptococcal Infection			416
The Use of Antibiotics in Management of PROM	417		
Method of Delivery of a Preterm Infant with PROM	417		
Summary	418	References	420

## 17 Intrapartum Fetal Monitoring 425

Peter Renou, Carl Wood, and Judith Lumley

Fetal Heart Rate	426	Factors Influencing Human Fetal Heart	
Rate	428	Fetal Scalp Blood Sampling	434
Factors Influencing Fetal Scalp Blood pH	435	Application of	
Fetal Heart Rate Monitoring and Fetal Scalp Blood Sampling			437
Value of Intrapartum Fetal Monitoring	444		
References	450		

## 18 Fetal Monitoring and Meconium-Stained Amniotic Fluid 457

Harold E. Fox

Meconium Passage	457	The Problem of Meconium	
Aspiration	459	Significance of Meconium in Labor	459
The Application of Fetal Monitoring	460	Postdate Pregnancy	
and Meconium	462	Intrauterine Meconium	
Aspiration	462	Intrapartum Monitoring	464
Neonatal Management	466	Summary and	
Conclusions	466	References	467

## 19 The Importance of Plasma Volume Expansion to Normal Pregnancy 469

Robert C. Goodlin

Therapy	471	Subacute Therapy	472	Chronic	
Plasma Volume Expansion Therapy	472	General			
Concepts	472	References	476		



Niels H. Lauersen

Indications for Fetal Scalp Blood Sampling	480
Contraindications to Acid-Base Fetal Evaluation	482
Methodology of Acid-Base Determination	482
Complications with Fetal Scalp Blood Sampling	487
Errors in Fetal Blood Sampling	488
Blood Sampling	490
Labor	492
Patient	493
Indications for Continuous Fetal Scalp Tissue pH Monitoring	495
The Future of Continuous Fetal Scalp pH Monitoring	497
References	500

Index

505