

Handbook of Neonatology

Second Edition

Rita G. Harper

Jing Ja Yoon

Handbook of Neonatology

Second Edition

Rita G. Harper, M.D.

Chief, Division of Perinatal Medicine

North Shore University Hospital

Associate Professor of Pediatrics and Obstetrics and Gynecology

Cornell University Medical College

New York, New York

Jing Ja Yoon, M.D.

Chief, Neonatal Perinatology

Bronx-Lebanon Hospital Center

Associate Professor of Pediatrics

Albert Einstein College of Medicine

New York, New York



YEAR BOOK MEDICAL PUBLISHERS, INC.

Chicago • London

Copyright © 1974, 1987 by Year Book Medical Publishers, Inc. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—with prior written permission from the publisher. Printed in the United States of America.

1 2 3 4 5 6 7 8 9 0 CY 91 90 89 88 87

Library of Congress Cataloging-in-Publication Data

Harper, Rita G., 1934–
Handbook of neonatology.

Includes bibliographies and index.

I. Neonatology. I. Yoon, Jing Ja, 1941–
II. Title. [DNLM: 1. Infant, Newborn, Diseases.
WS 420 H295h]
RJ251.H26 1986 618.92'01 85-29520
ISBN 0-8151-4144-0

Sponsoring Editor: Stephany S. Scott
Manager, Copyediting Services: Frances M. Perveiler
Production Project Manager: Max Perez
Proofroom Supervisor: Shirley E. Taylor

To those who devoted their time,
talent, and academic careers so
that newborns might live.

Preface to the First Edition

In the last 10 years, pediatricians have become increasingly aware that most newborns who die do so within the first 24 hours of life. Thus, the concept of immediate care for the newborn to prevent serious illness has arisen.

Unfortunately, the first physician to see the infant is frequently an intern or resident who is in the training phase of medicine. Emergencies frequently arise when the intern is alone, the hour is late and time is of the essence. Serious clinical changes in the newborn are frequently so minimal and subtle that it is difficult for the intern to determine if and when he has a problem.

This handbook, therefore, was designed to be a functional guide to help the house staff recognize, prevent and treat emerging neonatal problems before the infant becomes seriously ill. It is not a textbook or replacement for a textbook. Although we hope that it will be of value to the general pediatrician, general obstetrician, family physician, nurse midwife, nursery nurse and physician's assistant, it can best be considered as a practical guide for the lonesome intern.

RITA G. HARPER, M.D.
JING JA YOON, M.D.

Preface to the Second Edition

The paper children in the hall,
Pinned against the nursery wall,
Call! call! call!
To those still held behind the glass,
The almost-lad and almost-lass
Pass! pass! pass!

R.G.H.

In the 13 years that have elapsed since the first edition of this handbook the breadth of perinatal knowledge has become ever more expansive, diagnostic possibilities considerably more complex, and monitoring and therapeutic modalities substantially more sophisticated. The house officer must be able to quickly recognize multiple life-threatening situations, understand a compendium of disease entities, and offer a variety of therapeutic modalities.

To accomplish this Herculean task, the house officer requires a convenient source of information that will rapidly retrieve normal and pathologic data, aid in relating clinical observations to diagnostic possibilities, and suggest current recommendations for supportive or therapeutic modalities. This handbook was developed to be such a guide.

The chapters were purposely designed to be problem-oriented since this is the common method by which the house officer approaches the nursery situation. Chapters are subdivided into general concepts and normal values, common differential diagnoses, disease entities, risk/preventions, clinical/laboratory observations, supportive management, and specific therapy. In some situations, the rapidly changing state of the art only permits controversial therapies to be suggested. We have therefore attempted to provide a knowledge base that will allow the house officer to understand the common problems associated with perinatal illness, support life functions of immediate significance, and handle events until the literature or a senior colleague can be consulted.

This handbook should not be considered a textbook of perinatal medicine. This, like the previous edition, can best be considered a practical guide for the lonesome intern.

RITA G. HARPER
JING JA YOON

Acknowledgments

It is with pleasure and gratitude that the authors acknowledge the assistance and support of their many colleagues and associates.

Mervin Silverberg, M.D., Director of the Department of Pediatrics at North Shore University Hospital, and William Caspe, M.D., Chairman of the Department of Pediatrics at Bronx-Lebanon Hospital, were major sources of encouragement throughout the preparation of this manuscript.

We are greatly indebted to our colleagues for their contributions. Concepcion Sia, M.D., assisted in the revision and development of Chapter 5, "Normal Full-term Infants," Mae Hee Kim, M.D., Chapter 14, "Anemia and/or Hemorrhage," Shaista Usmani, M.D., Chapter 15, "Tremors and Convulsions," and Jerrold Schlessel, M.D., Chapter 11, "Respiratory Distress," and Chapter 12, "Cyanosis." Eduvigis Carrera, M.D., Ph.D., reviewed the feeding practices for newborn infants in Chapter 6.

Library research assistants included Bonnie Claire Harper, Andrea Green, Deborah Karp, Roger Villi and Juan Gomez. Their tenacity and capability for finding even obscure references is greatly appreciated.

Our neonatal fellows over several years have been especially helpful. In the past year, the fellows have included Drs. Ronald Saintonge, Ezequiel Cartaya, Shudir Madisetty, Howard Fisher, Pratibha Kabrawala, Ilya Kreyzin, Marc de Soler, and Jenny Pan.

Through the many drafts and revisions, our secretarial assistants Florence Harris, Olivia Mosby and Rhoda Seligson have shown unending patience. Without their valuable assistance this book could not have been completed.

Last but not least, we wish to thank our husbands, Richard Harper and Jae Chan Kim, and children, Bonnie Claire, Robin Anne, and Susan Linda Harper, whose love and understanding allowed us to believe that--no matter how many

RITA G. HARPER
JING JA YOON

Contents

<i>PREFACE TO THE FIRST EDITION</i>	vii
<i>PREFACE TO THE SECOND EDITION</i>	ix
1 / Orientation to the Nursery	1
2 / The Role of the Pediatrician Before Delivery	3
Common Maternal Conditions or Diseases During	
Pregnancy	3
Fetal Conditions	3
Table 2-1—The Role of the Pediatrician for Maternal and Fetal High-Risk Conditions Before Delivery	4
Table 2-2—Common Methods Used to Assess	
Fetal Well-Being	12
Table 2-3—Assessment of Fetal Maturity by Amniotic Fluid Assay	16
Table 2-4—Conditions Diagnosable by Amniocentesis	17
Table 2-5—Drugs Given to or Taken by the Mother That May Affect the Fetus or Newborn	18
3 / Delivery Room Resuscitation Procedures	22
I. Preparation	22
II. General Resuscitative Measures for All Infants	24
III. Clinical Classification and Management of the Newborn	
Infant Based on the Apgar Scoring System	25
Table 3-1—Rapid Delivery Room Assessment of the Distressed Newborn to Determine Immediate Management	35
4 / Transportation of the Newborn From the Delivery Room	40
I. Transportation Requirements	40
Table 4-1—Prenatal and Delivery History	41

Table 4-2—Explanation of Prenatal and Delivery	45
II. Classification of Infants on Arrival in the Nursery	45
5 / Normal Fullterm Infants	46
I. Admission Policies for Normal Fullterm Infants	46
Table 5-1—Newborn Physical Examinations	47
Table 5-2—Factors to Consider Concerning the Newborn	
Physical Examination	48
Table 5-3—Common Birth Injuries	59
II. Feeding of the Normal Fullterm Infant	66
Table 5-4—Drugs Excreted in Human Milk	67
6 / Low-Birth-Weight Infants	74
I. Admission Policies for the Low-Birth-Weight Infant	74
II. The Premature Infant	75
Table 6-1—Suggested Daily Fluid Requirement	
in the Newborn Period	84
Table 6-2—Neutral Thermal Environmental	
Temperatures	84
Table 6-3—Daily Caloric Expenditure and Fluid Loss	88
Table 6-4—Estimated Daily Requirement for Nutrients	91
Table 6-5—Suggested Initial Quantity of Fluid to Be	
Administered by Nipple or by Nasogastric Tube	95
Table 6-6—Total Parenteral Nutrition Order Sheet	103
Table 6-7—Commercially Available Amino Acid and Fat	
Solutions for Total or Partial Parenteral Nutrition	104
Table 6-8—Partial or Total Parenteral Nutrition	
Surveillance Schedule	105
III. The Small-for-Gestational-Age Infant	106
7 / Large-for-Gestational-Age Infants	111
I. Common Causes of the Large-for-Gestational-	
Age Infant	111
II. Admission Policies for the Large-for-Gestational-	
Age Infant	112
III. Suggested Routine Orders for the Large-for-	
Gestational-Age Infant	113
8 / High-Risk Infants	115
I. Common Causes of an Infant Being Considered	
High Risk	115
II. Preparation	116

III. Admission Policies for the High-Risk Infant	118
Table 8-1—High-Risk Infants: Common Complications, Clinical Manifestations, Admission Studies, and Preventive Management	119
Table 8-2—Respiratory Sheet for High-Risk Infants	134
Table 8-3—Laboratory Flow Sheet for High-Risk Infants	135
9 / Infants With Congenital Malformations	136
I. Glossary	136
II. Common "At-Risk" Categories Associated With the Development of Congenital Malformations	137
III. What the Physician Should Do When Confronted With an Infant With Congenital Malformations	138
Table 9-1—Recurrence Risks for Common Congenital Malformations	139
Table 9-2—Estimated Rate of Chromosome Abnormalities Per 1,000 Live Births by 5-Year Interval	140
Table 9-3—Relative Timing and Developmental Pathology of Certain Malformations	141
Table 9-4—Frequently Observed Malformation Complexes and Syndromes	143
IV. Specific Management for Infants With Congenital Malformations	164
10 / Discharge Policies	165
I. Healthy, Normal Fullterm Infants	165
II. Early Neonatal Discharge	165
III. Premature and High-Risk/Sick Infants	166
11 / Respiratory Distress	167
I. Normal Data	167
II. Common Causes of Respiratory Distress in the Newborn Infant	171
III. What the Physician Should Do When Confronted With an Infant With Respiratory Distress	172
IV. Oxygen Therapy	174
V. Retinopathy of Prematurity: Retrolental Fibroplasia	177
Table 11-1—Time Schedule for Fundus Examination	182
VI. Assisted Ventilation	184
VII. Chest Physiotherapy	195
VIII. Respiratory Distress Syndrome (Hyaline Membrane Disease)	197

IX. Transient Tachypnea of the Newborn	201
X. Apnea	202
XI. Pneumonia	205
XII. Meconium Aspiration Syndrome	207
XIII. Persistent Pulmonary Hypertension of the Newborn (Persistent Fetal Circulation)	210
XIV. Pulmonary Air Leak Syndrome	213
XV. Pulmonary Hemorrhage	217
XVI. Bronchopulmonary Dysplasia	219
XVII. Congenital Lung Cyst	222
XVIII. Tracheoesophageal Fistula	224
XIX. Diaphragmatic Hernia	226
XX. Pulmonary Hypoplasia	228
Table 11-2—Infants With Thoracic Cage Anomalies	230
XXI. Atelectasis	232
XXII. Upper Airway Obstruction	234
XXIII. Congenital Lobar Emphysema	236
XXIV. Congenital Cystic Adenomatoid Malformation of the Lung	238
XXV. Pleural Effusion	239
XXVI. Pulmonary Lymphangiectasis	240
XXVII. Phrenic Nerve Palsy	241
XXVIII. Congenital Heart Disease	242
Table 11-3—Congenital Heart Disease in the Newborn	244
XXIX. Congestive Heart Failure	250
XXX. Patent Ductus Arteriosus	253
XXXI. Arrhythmias (Dysrhythmias)	257
Table 11-4—Common Arrhythmias Seen in the Newborn Infant	258
12 / Cyanosis	260
I. Clinical Evaluation	260
II. Common Causes of Cyanosis in the Newborn	261
III. What the Physician Should do When Confronted With an Infant With Cyanosis	262
IV. General Supportive Management	265
V. Polycythemia and Hyperviscosity	265
VI. Methemoglobinemia	268
13 / Jaundice	270
I. Normal Data	270
II. Common Causes of Jaundice in the Newborn Infant	271

III. What the Physician Should Do When Confronted With an Infant With Jaundice	273
IV. Kernicterus: Bilirubin Encephalopathy	275
V. Phototherapy	277
VI. Exchange Transfusion	280
VII. Rh Incompatibility	286
VIII. ABO Incompatibility	292
IX. Minor Group Incompatibility	294
X. Glucose-6-Phosphate Dehydrogenase Deficiency	295
Table 13-1—Some Agents Reported to Produce Hemolysis in Patients With G-6-PD Deficiency	297
XI. Hereditary Spherocytosis	298
XII. Breast Milk Jaundice	299
XIII. Heinz Body Anemia	300
XIV. Familial Nonhemolytic Unconjugated Hyperbilirubinemia: Crigler-Najjar Syndrome, Types I and II	301
XV. Hepatocellular Cholestatic Jaundice	302
Table 13-2—Laboratory Tests Differentiating Biliary Atresia From Hepatocellular Cholestasis	303
XVI. Cholestatic Jaundice Due to Biliary Atresia	304
XVII. Inherited Conjugated Hyperbilirubinemia: Dubin-Johnson Syndrome, Rotor's Syndrome	306
14 / Anemia and Hemorrhage	308
I. Normal Data	308
II. Common Causes of Anemia and/or Hemorrhage	311
III. What the Physician Should Do When Confronted With an Infant With Anemia and/or Hemorrhage	312
Table 14-1—Maternal Events Associated With Neonatal Hematologic Abnormalities	313
Table 14-2—Common Clinical Manifestations of Neonatal Internal Hemorrhage	315
Table 14-3—Clinical and Laboratory Manifestations of Acute and Chronic Hemorrhage	316
Table 14-4—Coagulation Studies	317
IV. Fetomaternal Transfusion	323
V. Twin-to-Twin (Feto-Fetal) Transfusion	325
VI. Fetal-placental Hemorrhage	327
VII. Traumatic Amniocentesis	328
VIII. Placenta Previa	329
IX. Abruptio Placentae	330

xviii CONTENTS

X. Internal Hemorrhage	331
XI. Vitamin K Deficiency (Hemorrhagic Disease of the Newborn)	332
XII. Disseminated Intravascular Coagulation	334
XIII. Inherited Clotting Factor Disorders	335
Table 14-5—Coagulation Factors and Mode of Inheritance	336
Table 14-6—Replacement Therapy for Hemostatic Defects	337
Table 14-7—Blood Products and Other Forms of Therapy for Coagulation Disorders	338
XIV. Hemorrhage Due to Platelet Abnormalities	339
XV. Anemia of Prematurity	343
XVI. Congenital Hypoplastic Anemia	347
Table 14-8—Congenital Failure of RBC Production (Aplastic Anemia)	348
 15 / Tremors and Convulsions	 349
I. Clinical Evaluation	349
II. Common Causes of Tremors or Convulsions in the Newborn	350
III. What the Physician Should Do When Confronted With an Infant With Tremors and/or Convulsions	352
IV. Perinatal Asphyxia: Hypoxic-Ischemic Encephalopathy	355
V. Metabolic Acidosis in the Newborn	359
Table 15-1—Conditions Associated With Metabolic Acidosis in the Newborn	360
VI. Periventricular-Intraventricular Hemorrhage	363
VII. Subdural Hemorrhage	366
VIII. Subarachnoid Hemorrhage	368
IX. Hypocalcemia	369
X. Hypoglycemia	372
XI. The Infant of a Diabetic Mother	376
XII. Hyperglycemia	379
XIII. Hypomagnesemia	381
XIV. Hyponatremia	383
XV. Hypernatremia	386
XVI. Hyperammonemia	388
XVII. Pyridoxine (Vitamin B ₆) Deficiency or Dependency	391
XVIII. Hyperthyroidism	392

XIX. Drug Withdrawal Syndrome in the Infants of Drug-Addicted Mothers	394
XX. Fetal Alcohol Syndrome, Alcohol-Related Birth Defects, and Neonatal Alcohol Withdrawal	398
Table 15-2—Disorders of Neuronal Proliferation, Migration, Organization, and Myelination	401
Table 15-3—Inborn Errors of Metabolism Associated With Seizures in the Newborn	404
16 / Poor Feeding, Poor Cry, and Poor Muscle Tone	407
I. Clinical Evaluation: Normal Data	407
II. Common Causes of Poor Feeding, Poor Cry, and Poor Muscle Tone	407
III. What the Physician Should Do When Confronted With an Infant Suspected of Having an Infection	409
Table 16-1—Dosage and Complications of Antibiotic Therapy in the Newborn	413
IV. Congenital Rubella (German Measles)	418
V. Cytomegalovirus Infection	421
VI. Congenital Toxoplasmosis	424
VII. Herpes Simplex	427
VIII. Varicella (Chickenpox)	431
IX. Coxsackie B Virus Infections	433
X. Congenital Syphilis	435
XI. Tuberculosis	439
XII. Hepatitis	442
XIII. Listeriosis	446
XIV. Chlamydial Infection	448
XV. Group B Streptococcal Infection	450
XVI. Staphylococcal Infections	454
XVII. Gonorrhea	457
XVIII. Candidiasis	459
XIX. Sepsis	462
XX. Neonatal Meningitis	466
XXI. Urinary Tract Infection	470
XXII. Diarrhea of the Newborn	472
XXIII. Acquired Immunodeficiency Syndrome	478
Table 16-2—Ophthalmia Neonatorum	482
Table 16-3—Effects of Uncommon Maternal Infection on the Fetus and Neonate	484
XXIV. Poor Muscle Tone: "The Floppy Infant"	485
Table 16-4—Infants With Hypotonia	486
Table 16-5—Common Glycogen Storage Diseases	488

xx CONTENTS

17 / Vomiting and Abdominal Distention	490
I. Clinical Evaluation	490
II. Common Causes of Vomiting and Abdominal Distention in the Newborn	492
III. What the Physician Should Do When Confronted With an Infant With Vomiting and/or Abdominal Distention	493
IV. Mechanical Intestinal Obstruction	497
V. Meconium Plug Syndrome	499
Table 17-1—Causes of Difficulties With Suck and Swallow	501
Table 17-2—Disorders of Neuromuscular Control of the Pharynx, Esophagus, and Pylorus	502
VI. Meconium Ileus	503
VII. Cystic Fibrosis	505
VIII. Atresia and Stenosis of the Anal Canal (Imperforate Anus)	507
IX. Small Left Colon Syndrome	510
X. Malrotation With Volvulus	511
XI. Annular Pancreas	513
XII. Gastroesophageal Reflux (Chalasia)	514
XIII. Pyloric Stenosis	516
XIV. Hirschsprung's Disease	518
XV. Gastric Perforation	520
XVI. Necrotizing Enterocolitis	522
XVII. Hypermagnesemia	525
XVIII. Hypokalemia	526
XIX. Hypothyroidism	528
XX. Neonatal Ascites	533
Table 17-3—Ascites: Causes, Manifestations, and Management	534
XXI. Omphalocele	535
XXII. Gastroschisis	537
Table 17-4—Tumor Masses of the Neonate	538
Table 17-5—Clinical and Biochemical Features in Newborn Adrenal Insufficiency	540
Table 17-6—Comparative Summary of Disorders of Sexual Differentiation	54
18 / Edema and/or Oliguria	543
I. Normal Data: Physiologic Edema	543
II. Common Causes of Edema and/or Oliguria in the Newborn	546

III. What the Physician Should Do When Confronted With an Infant With Edema and/or Oliguria	547
IV. Acute Renal Failure	550
V. Acute Renal Cortical Necrosis	555
VI. Neonatal Systemic Hypertension.	556
VII. Renal Artery Thrombosis/Embolii	559
VIII. Renal Vein Thrombosis	560
IX. Cystic Kidney Disease	561
X. Congenital Nephrotic Syndrome	564
XI. Obstructive Uropathy and Hydronephrosis	566
XII. Hydrops Fetalis	569
XIII. Zinc Deficiency	571
XIV. Copper Deficiency	573
XV. Syndrome of Inappropriate Antidiuretic Hormone	574
XVI. Hyperkalemia	575
 19 / Procedures Commonly Used in the Nursery	578
I. Vessel Puncture/Catheterization/Cutdown	578
A. Heel Puncture for Capillary Blood Specimen.	578
B. Venous Puncture for Venous Blood Specimen	579
C. Umbilical Vein Catheterization	580
D. Central Venous Catheter Placement	581
E. Percutaneous Central Venous Catheter Placement	581
F. Internal Saphenous Vein Cutdown	582
G. Arterial Puncture for Arterial Blood Specimen	583
H. Umbilical Artery Catheterization	584
II. Tapping Various Organs/Cavities	585
A. Suprapubic Bladder Tap.	585
B. Spinal Tap.	585
C. Pericardial Tap.	586
D. Thoracentesis (Needle Aspiration)	587
E. Tube Thoracotomy (Closed Intercostal Drainage)	588
F. Subdural Tap	589
III. Transillumination	590
A. The skull	590
B. The Chest.	590
C. The Abdomen	591
IV. Tracheal Intubation	591
A. Orotracheal Intubation	591
B. Nasotracheal Intubation	591
V. Feeding Tube Insertion and TPN.	592
A. Nasogastric Tube	592
B. Total or Partial Parenteral Nutrition.	592

VI. Miscellaneous Procedures	593
A. Tracheostomy	593
B. Removal of Extra Digits and Skin Tags	594
C. Blood Pressure by Doppler or Oscillometric Method	594
VII. Electrocardiogram	595
A. Technique of Taking an ECG in the Newborn	595
B. Definitions of Electrocardiographic Configurations	596
C. Normal Values	597
D. Abnormal Findings	598
Appendix A	606
CARDIRESPIRATORY DATA	
Table A-1—Average Systolic, Diastolic, and Mean Blood Pressures During the First 12 Hours of Life in Normal Newborn Infants Grouped According to Birth Weight	607
Fig A-1—Aortic Blood Pressure	608
Fig A-2—Systolic Blood Pressure	609
Table A-2—Electrocardiographic Standards in Term Neonates	610
Table A-3—Normal Electrocardiographic Values in Fullterm and Premature Infants	611
Table 4-4—Relationship of Age, Total Blood Volume, and Body Weight of Infants	612
Table A-5—Pulmonary Ventilation of the Infant	612
Table A-6—Endotracheal Tube Size	613
Table A-7—Insertion Distance of Endotracheal Tube	613
Fig A-3—Estimation of Nasotracheal Tube Length	614
Table A-8—Arterial Blood Gases and Acid Base Balance in the Normal Newborn	615
Table A-9—Arterial Blood Gas Values in Normal Premature Infants	616
Fig A-4—Siggaard-Anderson Normogram	617
HEMATOLOGIC VALUES	
Table A-10—Normal Hematologic Values During the First 12 Weeks of Life	618
Table A-11—Normal Red Blood Cell Values in Term and Low-Birth-Weight Infants, First 8 Weeks of Life	619
Table A-12—Normal White Blood Cell Values in Term and Premature Infants	620
Fig A-5—Total Neutrophil Count	621
Fig A-6—Immature/Total Neutrophils Ratio in the First 60 Hours of Life	622