

# POCKET**RADIOLOGIST**<sup>TM</sup>

---

## Pediatrics

### Top 100 Diagnoses

Donnelly

O'Hara

Westra

Blaser



# PocketRadiologist™

## Pediatrics

### 100 Top Diagnoses

---

#### **Lane F Donnelly MD**

Associate Director, Department of Radiology  
Cincinnati Children's Hospital Medical Center  
Professor of Radiology and Pediatrics  
University of Cincinnati, College of Medicine  
Cincinnati, Ohio

#### **Sara M O'Hara MD**

Chief, Section of Ultrasound  
Associate Professor of Radiology and Pediatrics  
Cincinnati Children's Hospital Medical Center  
Cincinnati, Ohio

#### **Sjirk J Westra MD**

Pediatric Radiologist  
Massachusetts General Hospital  
Associate Professor of Radiology  
Harvard Medical School  
Boston, MA

#### **Susan I Blaser MD FRCP(C)**

Neuroradiologist  
The Hospital for Sick Children  
Associate Professor  
The University of Toronto  
Toronto, Canada

*With 200 drawings and radiographic images*

*Drawings:* Lane R Bennion MS  
Richard Coombs MS  
Jill Rhead MA  
James A Cooper MD  
Walter Stuart MFA

*Image Editing:* Ming Q Huang MD  
Melissa Petersen



**W. B. SAUNDERS COMPANY**  
An Elsevier Science Company



A medical reference publishing company

## **First Edition**

Text - Copyright Lane F Donnelly 2002

Drawings - Copyright Amirsys Inc 2002

Compilation - Copyright Amirsys Inc 2002

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or media or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from Amirsys Inc.

First Printing: April 2002

Second Printing: October 2002

Composition by Amirsys Inc, Salt Lake City, Utah

Printed in China

ISBN: 0-7216-0672-5

**袖珍放射专家——儿科的 100 个主要诊断**

[美]唐纳利 著

Amirsys Inc 出版

**上海世界图书出版公司 重印发行**

2004 年 4 月第 1 版

上海市尚文路 185 号 B 楼 邮政编码 200010

各地新华书店经销 (限中华人民共和国国内发行)

图字: 09-2004-034 号

ISBN 7-5062-6533-8 /R · 63

定价: 140.00 元

## Preface

The **PocketRadiologist™** series is an innovative, quick reference designed to deliver succinct, up-to-date information to practicing professionals “at the point of service.” As close as your pocket, each title in the series is written by world-renowned authors, specialists in their area. These experts have designated the “top 100” diagnoses in every major body area, bulleted the most essential facts, and offered high-resolution imaging to illustrate each topic. Selected references are included for further review. Full color anatomic-pathologic computer graphics model many of the actual diseases.

Each **PocketRadiologist™** title follows an identical format. The same information is in the same place—every time—and takes you quickly from key facts to imaging findings, differential diagnosis, pathology, pathophysiology, and relevant clinical information.

**PocketRadiologist™** titles are available in both print and hand-held PDA formats. Our first modules feature Brain, Head and Neck, and Orthopedic (Musculoskeletal) Imaging. Additional titles include Spine and Cord, Chest, Breast, Vascular, Cardiac, Pediatrics, Emergency, and Genital Urinary, and Gastro Intestinal. Enjoy!

Anne G Osborn MD  
Editor-in-Chief, Amirsys Inc

## Notice and Disclaimer

The information in this product ("Product") is provided as a reference for use by licensed medical professionals and no others. It does not and should not be construed as any form of medical diagnosis or professional medical advice on any matter. Receipt or use of this Product, in whole or in part, does not constitute or create a doctor-patient, therapist-patient, or other healthcare professional relationship between Amirsys Inc. ("Amirsys") and any recipient. This Product may not reflect the most current medical developments, and Amirsys makes no claims, promises, or guarantees about accuracy, completeness, or adequacy of the information contained in or linked to the Product. The Product is not a substitute for or replacement of professional medical judgment. Amirsys and its affiliates, authors, contributors, partners, and sponsors disclaim all liability or responsibility for any injury and/or damage to persons or property in respect to actions taken or not taken based on any and all Product information.

In the cases where drugs or other chemicals are prescribed, readers are advised to check the Product information currently provided by the manufacturer of each drug to be administered to verify the recommended dose, the method and duration of administration, and contraindications. It is the responsibility of the treating physician relying on experience and knowledge of the patient to determine dosages and the best treatment for the patient.

To the maximum extent permitted by applicable law, Amirsys provides the Product AS IS AND WITH ALL FAULTS, AND HEREBY DISCLAIMS ALL WARRANTIES AND CONDITIONS, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING BUT NOT LIMITED TO, ANY (IF ANY) IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, OF LACK OF VIRUSES, OR ACCURACY OR COMPLETENESS OF RESPONSES, OR RESULTS, AND OF LACK OF NEGLIGENCE OR LACK OF WORKMANLIKE EFFORT. ALSO, THERE IS NO WARRANTY OR CONDITION OF TITLE, QUIET ENJOYMENT, QUIET POSSESSION, CORRESPONDENCE TO DESCRIPTION OR NON-INFRINGEMENT, WITH REGARD TO THE PRODUCT. THE ENTIRE RISK AS TO THE QUALITY OF OR ARISING OUT OF USE OR PERFORMANCE OF THE PRODUCT REMAINS WITH THE READER.

Amirsys disclaims all warranties of any kind if the Product was customized, repackaged or altered in any way by any third party.

# PocketRadiologist™

## **Pediatrics**

### **Top 100 Diagnoses**

---

The diagnoses in this book are divided into **7** sections in the following order:

**Chest**

**Airway**

**Cardiac**

**Gastrointestinal**

**Genitourinary**

**Musculoskeletal**

**Neuro**

# Table of Diagnoses

## Chest

Normal Thymus .....	1
<i>Lane F Donnelly MD</i>	
Meconium Aspiration Syndrome .....	4
<i>Lane F Donnelly MD</i>	
Rib Fractures from Abuse .....	7
<i>Lane F Donnelly MD</i>	
Surfactant Deficient Disease .....	10
<i>Lane F Donnelly MD</i>	
Congenital Lobar Emphysema .....	13
<i>Lane F Donnelly MD</i>	
CCAM .....	16
<i>Lane F Donnelly MD</i>	
Congenital Diaphragmatic Hernia .....	19
<i>Lane F Donnelly MD</i>	
Pulmonary Interstitial Emphysema .....	22
<i>Lane F Donnelly MD</i>	
Sequestration .....	25
<i>Lane F Donnelly MD</i>	
Bronchogenic Cyst .....	28
<i>Lane F Donnelly MD</i>	
Viral Disease .....	31
<i>Lane F Donnelly MD</i>	
Round Pneumonia .....	34
<i>Lane F Donnelly MD</i>	
Cavitary Necrosis in Pneumonia .....	37
<i>Lane F Donnelly MD</i>	
Thoracic Neuroblastoma .....	40
<i>Lane F Donnelly MD</i>	
Thoracic Discitis .....	43
<i>Lane F Donnelly MD</i>	

## Airway

Croup .....	46
<i>Lane F Donnelly MD</i>	
Epiglottitis .....	49
<i>Lane F Donnelly MD</i>	
Exudative Tracheitis .....	52
<i>Lane F Donnelly MD</i>	
Retropharyngeal Abscess .....	55
<i>Lane F Donnelly MD</i>	
Enlarged Tonsils .....	58
<i>Lane F Donnelly MD</i>	

Glossoptosis.....	61
<i>Lane F Donnelly MD</i>	
Bronchial Foreign Body .....	64
<i>Lane F Donnelly MD</i>	
Double Aortic Arch .....	67
<i>Lane F Donnelly MD</i>	
Pulmonary Sling .....	70
<i>Lane F Donnelly MD</i>	
Innominate Artery Compression .....	73
<i>Lane F Donnelly MD</i>	
Midline Descending Aorta .....	76
<i>Lane F Donnelly MD</i>	

## Cardiac

Tetralogy of Fallot .....	79
<i>Sjirk J Westra MD</i>	
Ebstein's anomaly .....	82
<i>Sjirk J Westra MD</i>	
Truncus Arteriosus .....	85
<i>Sjirk J Westra MD</i>	
Total Anomalous Pulmonary Venous Connection .....	88
<i>Sjirk J Westra MD</i>	
D-Transposition .....	91
<i>Sjirk J Westra MD</i>	
Left to Right Shunts .....	94
<i>Sjirk J Westra MD</i>	
Scimitar Syndrome.....	97
<i>Sjirk J Westra MD</i>	
Hypoplastic Left Heart Syndrome .....	100
<i>Sjirk J Westra MD</i>	
Vein of Galen Malformation.....	103
<i>Sjirk J Westra MD</i>	
Coarctation of Aorta .....	106
<i>Sjirk J Westra MD</i>	
Pulmonary Atresia.....	109
<i>Sjirk J Westra MD</i>	
Kawasaki Disease .....	112
<i>Sjirk J Westra MD</i>	
Cardiomyopathies .....	115
<i>Sjirk J Westra MD</i>	
Rhabdomyoma .....	118
<i>Sjirk J Westra MD</i>	

## Gastrointestinal

Necrotizing Enterocolitis.....	121
<i>Lane F Donnelly MD</i>	



Malrotation and Volvulus .....	124
<i>Lane F Donnelly MD</i>	
Duodenal Atresia & Stenosis .....	127
<i>Lane F Donnelly MD</i>	
Duodenal Web .....	130
<i>Lane F Donnelly MD</i>	
Hirschsprung Disease .....	133
<i>Lane F Donnelly MD</i>	
Meconium Plug Syndrome .....	136
<i>Lane F Donnelly MD</i>	
Ileal Atresia .....	139
<i>Lane F Donnelly MD</i>	
Meconium Ileus .....	142
<i>Lane F Donnelly MD</i>	
Esophageal Atresia .....	145
<i>Lane F Donnelly MD</i>	
Hypertrophic Pyloric Stenosis .....	148
<i>Sara M O'Hara MD</i>	
Appendicitis .....	151
<i>Lane F Donnelly MD</i>	
Intussusception .....	154
<i>Lane F Donnelly MD</i>	
Meckel Diverticulum .....	157
<i>Sara M O'Hara MD</i>	
Biliary Atresia .....	160
<i>Sara M O'Hara MD</i>	
Hepatoblastoma .....	163
<i>Lane F Donnelly MD</i>	
Hemangioendothelioma .....	166
<i>Lane F Donnelly MD</i>	
Hypoperfusion Complex .....	169
<i>Lane F Donnelly MD</i>	

## Genitourinary

Acute Pyelonephritis .....	172
<i>Sara M O'Hara MD</i>	
Vesicoureteral Reflux .....	175
<i>Sara M O'Hara MD</i>	
Ureteropelvic Junction Obstruction .....	178
<i>Sara M O'Hara MD</i>	
Multicystic Dysplastic Kidney .....	181
<i>Sara M O'Hara MD</i>	
Ureterocele .....	184
<i>Sara M O'Hara MD</i>	
Renal Ectopia and Fusion .....	187
<i>Sara M O'Hara MD</i>	

Posterior Urethral Valves .....	190
<i>Sara M O'Hara MD</i>	
Hydrometrocolpos .....	193
<i>Sara M O'Hara MD</i>	
Wilms Tumor .....	196
<i>Sara M O'Hara MD</i>	
Neuroblastoma .....	199
<i>Lane F Donnelly MD</i>	
Neonatal Adrenal Hemorrhage .....	202
<i>Sara M O'Hara MD</i>	
Pelvic Rhabdomyosarcoma .....	205
<i>Sara M O'Hara MD</i>	
Sacroccygeal Teratoma .....	208
<i>Sara M O'Hara MD</i>	
Testicular Torsion .....	211
<i>Sara M O'Hara MD</i>	
Epididymitis & Epididymoorchitis .....	214
<i>Sara M O'Hara MD</i>	

## **Musculoskeletal**

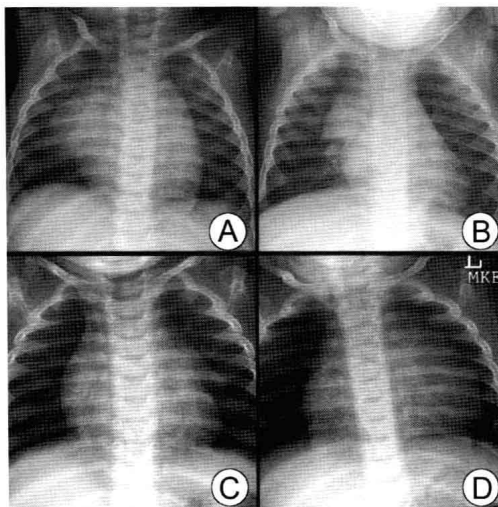
Incomplete Fractures .....	217
<i>Lane F Donnelly MD</i>	
Salter Fracture .....	220
<i>Lane F Donnelly MD</i>	
Supracondylar Fracture .....	223
<i>Lane F Donnelly MD</i>	
Toddler's Fracture .....	226
<i>Lane F Donnelly MD</i>	
Metaphyseal Corner Fracture .....	229
<i>Lane F Donnelly MD</i>	
Osgood-Schlatter Disease .....	232
<i>Lane F Donnelly MD</i>	
Langerhans Cell Histiocytosis .....	235
<i>Lane F Donnelly MD</i>	
Ewing Sarcoma .....	238
<i>Lane F Donnelly MD</i>	
Osteomyelitis .....	241
<i>Lane F Donnelly MD</i>	
Osteoid Osteoma .....	244
<i>Lane F Donnelly MD</i>	
Osteosarcoma .....	247
<i>Lane F Donnelly MD</i>	
Chronic Foreign Body .....	250
<i>Lane F Donnelly MD</i>	
Developmental Dysplasia of the Hip .....	253
<i>Sara M O'Hara MD</i>	
Slipped Capital Femoral Epiphysis .....	256
<i>Lane F Donnelly MD</i>	

Legg-Calvé-Perthes .....	259
<i>Lane F Donnelly MD</i>	
Venous Malformation .....	262
<i>Lane F Donnelly MD</i>	
Lymphatic Malformation .....	265
<i>Lane F Donnelly MD</i>	
Hemangioma .....	268
<i>Lane F Donnelly MD</i>	

## Neuro

Germinal Matrix Hemorrhage .....	271
<i>Sara M O'Hara MD</i>	
Periventricular Leukomalacia .....	274
<i>Sara M O'Hara MD</i>	
Tethered Cord – Spinal Ultrasound .....	277
<i>Sara M O'Hara MD</i>	
Common Neurocutaneous Disorders .....	280
<i>Susan I Blaser MD FRCP(C)</i>	
Pediatric Posterior Fossa Tumors .....	283
<i>Susan I Blaser MD FRCP(C)</i>	
Pediatric Brainstem Glioma, BSG .....	286
<i>Susan I Blaser MD FRCP(C)</i>	
Non-Accidental Trauma, N.A.T. ....	289
<i>Susan I Blaser MD FRCP(C)</i>	
Craniosynostoses .....	292
<i>Susan I Blaser MD FRCP(C)</i>	
Hypoxic Ischemic, HIE .....	295
<i>Susan I Blaser MD FRCP(C)</i>	
Common Midline Anomalies .....	298
<i>Susan I Blaser MD FRCP(C)</i>	

# Normal Thymus



*Variations shown in the radiographic appearance of the normal thymus. (A) and (B) show infants with prominent rightward thymus. (C) shows a prominent leftward thymus and (D) shows a prominent thymus draped over the cardiac silhouette.*

## Key Facts

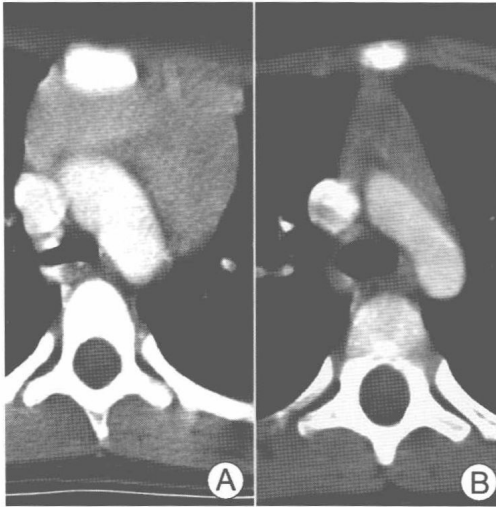
- Misinterpretation of the normal thymus as a potential mediastinal mass is not uncommon
- Normal thymus can be very prominent in size on radiography up to 5 years of age
- Historically, misinterpretation of prominent thymus as abnormal leads to unnecessary thymic irradiation therapy of numerous children

## Imaging Findings

### Features Associated with Normal Thymus

- Age
  - Can be quite large up to 5 years of age
  - Decreases in prominence by end of 1<sup>st</sup> decade of life
  - Should not appear as prominent mass during 2<sup>nd</sup> decade
- Gender
  - Prominent thymus much more common in boys
  - 80% of prominent thymuses are in boys
- Contour
  - Normal: Convex, undulating
  - Abnormal: Lobulated, poorly defined, irregular
- Shape
  - Variable
  - Can drape over cardiac silhouette and make heart look prominent
  - Can have prominent triangular extension leftward or rightward called "sail sign"
- Spinnaker sail sign refers to when a pneumomediastinum lifts the thymus superior off of the cardiac silhouette
  - On cross-sectional imaging
    - Young children: Quadrilateral
    - Older children: Triangular

## Normal Thymus



*CT findings of normal thymus. Thymus is homogeneous in attenuation with smooth borders. During early childhood (A), the thymus has a quadrilateral shape. During the second decade of life (B) the thymus has a more triangular shape.*

- Consistency
  - Homogeneous
  - No calcifications, areas of low attenuation
- Relationship to adjacent structures
  - Normal thymus "soft"
  - Does not compress adjacent structures
    - Airway
    - Superior vena cava
- Associated findings that favor abnormal thymus
  - Pleural or pericardial effusion
  - Lung disease

### CT Findings

- As above

### MR Findings

- As above

### Ultrasound Findings

- High frequency transducers demonstrate normal thymic septa as echogenic linear or dot-like echogenicities
- Considered characteristic for normal thymus
- Can be used to diagnose ectopic thymus or document normal but prominent thymus

### Imaging Recommendations

- If chest radiograph demonstrates prominent thymus that is questionably normal for age, imaging options include
  - Repeat chest radiograph in 6 weeks
  - CT of chest with contrast
  - Ultrasound to demonstrate normal architecture

## Differential Diagnosis

### Lymphoma

- By far most common cause of anterior mediastinal mass in children

### Germ Cell Tumor (teratoma)

- Calcifications and fat attenuation

### Thymic Cyst

- Calcifications and fat attenuation

### Langerhans Cell Histiocytosis

- Thymic involvement common in autopsy series
- Thymic mass with calcifications or low attenuation
- Lung cysts
- Hepatomegaly, periportal low attenuation, liver masses

## Pathology

### General

- Normal thymus prominent in relationship to relative size of thorax at birth and during first 5 years of life
- Begins to become smaller relative to chest by the end of 1<sup>st</sup> decade of life
- Continues to decrease in size for remainder of adulthood

## Clinical Issues

### General

- Differentiation of normal thymus from abnormal causes of anterior mediastinal masses

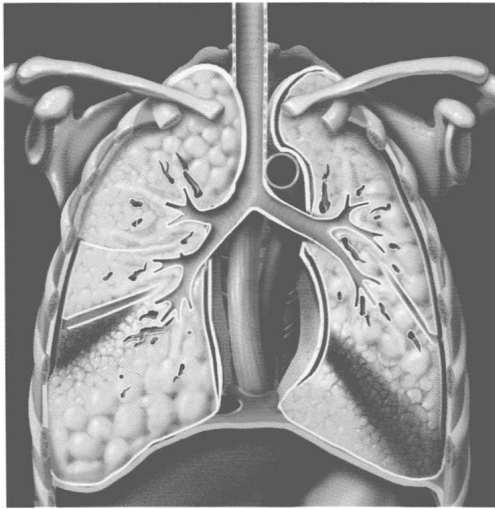
### Treatment

- None

## Selected References

1. Frush DP et al: Imaging evaluation of the thymus and thymic disorders in children. In: Pediatric Chest Imaging, eds. Strife JL, Lucaya J. Berlin; Springer-Verlag, 2001
2. Donnelly LF: Fundamentals of Pediatric Radiology. Philadelphia; W.B. Saunders, 2001
3. Jacobs MT et al: The right place at the wrong time: historical perspective of the relation of the thymus gland and pediatric radiology. Radiology 210:11-6, 1999

# Meconium Aspiration Syndrome



*Meconium aspiration syndrome. Diagram demonstrates findings: Asymmetric areas of hyperinflation and atelectasis as well as increased, ropelike perihilar densities.*

## Key Facts

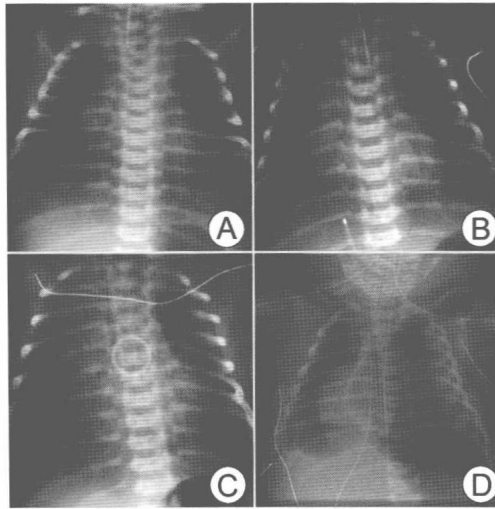
- Synonym(s): MAS
- Definition: Respiratory distress that occurs secondary to intrapartum or intrauterine aspiration of meconium
- Classic imaging appearance: Asymmetric hyperinflation and areas of lung consolidation with ropelike perihilar densities
- Aspirated meconium causes obstruction of small airways secondary to tenacious nature
- Aspirated meconium also causes chemical pneumonitis
- Airway obstruction and chemical pneumonitis lead to asymmetric areas of hyperinflation and consolidation
- Airway obstruction can lead to airblock complications such as pneumothorax
- More commonly occurs in full term or postmature infants, rather than premature infants

## Imaging Findings

### Radiographic Features

- Best imaging clue: High lung volumes, ropelike perihilar densities
- Differential for diffuse lung disease in neonates categorized based on lung volumes: High or low
- MAS associated with high lung volumes, often asymmetric
- Areas of asymmetric, patchy consolidation, atelectasis
- Areas of hyperinflation alternating with areas of atelectasis
- Ropelike perihilar densities
- Pleural effusion
- Airblock complications: Pneumothorax in 20–40 %

# Meconium Aspiration Syndrome



Four neonates with meconium aspiration syndrome. Neonates shown in (A-C) show varying degrees of ropelike perihilar densities and increased lung volumes. Neonate in (D) shows left pneumothorax with rightward mediastinal shift and partial left lung collapse.

## Differential Diagnosis: Neonatal Lung Disease with High Lung Volumes

### Neonatal Pneumonia

- Patchy asymmetric perihilar densities and hyperinflation

### Transient Tachypnea of the Newborn

- Occurs secondary to delayed clearance of fetal pulmonary fluid (often in cesarean section)
- Key feature is benign course
- Findings of CHF on radiographs often with high lung volumes

## Pathology

### General

- Meconium aspirated either intrapartum or intrauterine secondary to stress, such as hypoxia
- Aspirated meconium causes obstruction of small airways secondary to tenacious nature
- Aspirated meconium also causes chemical pneumonitis
- Airway obstruction and chemical pneumonitis lead to asymmetric areas of hyperinflation and consolidation
- Airway obstruction can lead to airblock complications such as pneumothorax

## Clinical Issues

### Presentation

- More commonly occurs in full term or postmature infants, rather than premature infants
- Present with respiratory distress

### Natural History

- Degree of respiratory distress may be severe



## Meconium Aspiration Syndrome

---

- Often associated with persistent fetal circulation
  - High pulmonary vascular resistance normally present in fetus fails to decrease (as is normal), resulting in persistent high pulmonary arterial pressures
  - Physiologic finding rather than disease
  - Can be primary or secondary to causes such as MAS
  - Associated with critical illness

### Treatment

- Often need ventilator support with conventional ventilators or high frequency ventilation
- Extracorporeal membrane oxygenation (ECMO) used as last resort

### **Selected References**

1. Cleveland RH: A radio logic update on medical diseases of the newborn chest. *Pediatr Radiol* 25:631-7, 1995
2. Gregory GA et al: Meconium aspiration in infants: a prospective study. *J Pediatr* 85:848-52, 1974
3. Gooding CA et al: Roentgenographic analysis of meconium aspiration of the newborn. *Radiology* 100:131-40, 1971