

---

# Atlas of Anatomic Pathology

**Series Editor**

Liang Cheng  
Indianapolis, Indiana  
USA

This Atlas series is intended as a “first knowledge base” in the quest for diagnosis of usual and unusual diseases. Each atlas will offer the reader a quick reference guide for diagnosis and classification of a wide spectrum of benign, congenital, inflammatory, nonneoplastic, and neoplastic lesions in various organ systems. Normal and variations of “normal” histology will also be illustrated. Each atlas will focus on visual diagnostic criteria and differential diagnosis. It will be organized to provide quick access to images of lesions in specific organs or sites. Each atlas will adapt the well-known and widely accepted terminology, nomenclature, classification schemes, and staging algorithms. Each volume in this series will be authored by nationally and internationally recognized pathologists. Each volume will follow the same organizational structure. The first Section will include normal histology and normal variations. The second Section will cover congenital defects and malformations. The third Section will cover benign and inflammatory lesions. The fourth Section will cover benign tumors and benign mimickers of cancer. The last Section will cover malignant neoplasms. Special emphasis will be placed on normal histology, gross anatomy, and gross lesion appearances since these are generally lacking or inadequately illustrated in current textbooks. The detailed figure legends will concisely summarize the critical information and visual diagnostic criteria that the pathologist must recognize, understand, and accurately interpret to arrive at a correct diagnosis. This book series is intended chiefly for use by pathologists in training and practicing surgical pathologists in their daily practice. The atlas series will also be a useful resource for medical students, cytotechnologists, pathologist assistants, and other medical professionals with special interest in anatomic pathology. Trainees, students, and readers at all levels of expertise will learn, understand, and gain insights into the complexities of disease processes through this comprehensive resource. Macroscopic and histological images are aesthetically pleasing in many ways. This new series will serve as a virtual pathology museum for the edification of our readers.

More information about this series at <http://www.springer.com/series/10144>

---

Xin Jing • Momin T. Siddiqui • Qing Kay Li  
Editors

# Atlas of Non-Gynecologic Cytology

 Springer

*Editors*

Xin Jing  
The University of Michigan-Michigan Medicine  
Ann Arbor, MI  
USA

Momin T. Siddiqui  
Weill-Cornell Medicine  
New York, NY  
USA

Qing Kay Li  
The Johns Hopkins Medical Institutions  
Baltimore, MD  
USA

Atlas of Anatomic Pathology

ISBN 978-3-319-89673-1 ISBN 978-3-319-89674-8 (eBook)

<https://doi.org/10.1007/978-3-319-89674-8>

Library of Congress Control Number: 2018945110

© Springer International Publishing AG, part of Springer Nature 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG part of Springer Nature

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*To my husband, Leilei Lin, for his continuous support and my mentor, Claire Michael, for instilling in me a passion for cytopathology.*

Xin Jing

*To my parents, Masud and Meher Siddiqui, for their love and guidance.*

Momin T. Siddiqui

*To my husband, my son, my family, Liz, Nathaniel and Emma, for their love and support.*

Qing Kay Li

---

## Series Preface

*One Picture Is Worth Ten Thousand Words — Frederick Barnard, 1927*

Remarkable progress has been made in anatomic and surgical pathology during the last 10 years. The ability of surgical pathologists to reach a definite diagnosis is now enhanced by immunohistochemical and molecular techniques. Many new clinically important histopathologic entities and variants have been described using these techniques. Established diagnostic entities are more fully defined for virtually every organ system. The emergence of personalized medicine has also created a paradigm shift in surgical pathology. Both promptness and precision are required of modern pathologists. Newer diagnostic tests in anatomic pathology, however, cannot benefit the patient unless the pathologist recognizes the lesion and requests the necessary special studies. An up-to-date atlas encompassing the full spectrum of benign and malignant lesions, their variants, and evidence-based diagnostic criteria for each organ system is needed. This atlas is not intended as a comprehensive source of detailed clinical information concerning the entities shown. Clinical and therapeutic guidelines are served admirably by a large number of excellent textbooks. This atlas, however, is intended as a “first knowledge base” in the quest for definitive and efficient diagnosis of both usual and unusual diseases.

The *Atlas of Anatomic Pathology* is presented to the reader as a quick reference guide for diagnosis and classification of benign, congenital, inflammatory, nonneoplastic, and neoplastic lesions organized by organ systems. Normal histology and variations are illustrated for each organ and anatomic system. The atlas focuses on visual diagnostic criteria and differential diagnosis. The organization is intended to provide quick access to images and confirmatory tests for each specific organ or site. The atlas adopts the well-known and widely accepted terminology, nomenclature, classification schemes, and staging algorithms.

This book series is intended chiefly for use by pathologists in training and practicing surgical pathologists in their daily practice. It is also a useful resource for medical students, cyto-technologists, pathologist assistants, and other medical professionals with special interest in anatomic pathology. We hope that our trainees, students, and readers at all levels of expertise will learn, understand, and gain insight into the pathophysiology of disease processes through this comprehensive resource. Macroscopic and histological images are aesthetically pleasing in many ways. We hope that the new series will serve as a virtual pathology museum for the edification of our readers.

Indianapolis, IN, USA

Liang Cheng, M.D.

---

## Preface

As we all know, cytology not only provides an accurate diagnosis at the cellular level by using minimally invasive procedures but also provides material for molecular characterization of a lesion/tumor for targeted therapy. In the era of personalized medicine, cytology has continued to grow and evolve as a critical diagnostic tool. Recently, the diagnostic criteria of tumors have become more refined, and certain terminology has been changed based on current TCGA (the Cancer Genome Atlas) data and WHO classifications. Therefore, it is necessary to update our knowledge and terminology in cytology.

In this book, we focus on all aspects of non-gynecologic cytopathology, from key features of benign and malignant lesions to diagnostic pearls and ancillary testing. Although this book is written by multiple authors, all chapters follow a similar format: brief introduction of the specific organ/system (including types of specimens and techniques to obtain samples), description of normal findings, and a practical approach to diagnose benign and malignant lesions. The key cytomorphological features and main differential diagnoses of lesions are also summarized in concise tables. Images in each chapter are instructive and represent findings. It also retains the quality and clarity of the *Atlas of Anatomic Pathology* series, and, like other volumes, this volume aims to be concise and comprehensive yet clinically relevant to daily practice. We also discuss important ancillary tests in each chapter, such as flow cytometry, immunohistochemistry, and molecular testing, which are crucial for an accurate diagnosis and differential diagnosis as well as for targeted therapy. The updated knowledge, key cytomorphological features, current terminology, and molecular diagnostic tests are the highlights of this book.

Finally, we wish for our book to be a practical resource for cytotechnologists, cytopathologists, and pathologists who are practicing general surgical pathology and cytopathology. The book will also be a valued text for medical students, residents, fellows, and other allied health personnel who take care and/or treat patients based on the histological diagnosis of diseases.

Ann Arbor, MI, USA  
New York, NY, USA  
Baltimore, MD, USA

Xin Jing, M.D.  
Momin T. Siddiqui, M.D., F.I.A.C.  
Qing Kay Li, M.D., Ph.D., F.C.A.P.

---

## Acknowledgements

First of all, we want to acknowledge our fellow cytopathologists, residents, and fellows for their help in collecting cases from their daily sign-out, and contributing to this book, which is a time-consuming process that often takes time away from other life duties. We also want to thank Dr. Liang Cheng for his role as the development editor of the atlas; Richard Hruska, executive editor; Lee Klein, senior editor for overseeing production; and others for their help during the production process.

---

## Contents

<b>1 Salivary Gland Fine Needle Aspiration</b> .....	1
He Wang, Aatika Malik, and Yun Gong	
<b>2 Thyroid Fine Needle Aspiration Cytology</b> .....	19
Xin Jing	
<b>3 Breast Cytology</b> .....	43
Gabriela Oprea-Ilies and Momin T. Siddiqui	
<b>4 Pulmonary Cytology</b> .....	103
Derek B. Allison and Qing Kay Li	
<b>5 Gastrointestinal Cytology</b> .....	133
Gabriela Oprea-Ilies and Momin T. Siddiqui	
<b>6 Pancreaticobiliary Tract Cytology</b> .....	157
Judy Pang and Andrew Sciallis	
<b>7 Liver Cytology</b> .....	173
Derek B. Allison, David Borzik, and Qing Kay Li	
<b>8 Kidney and Adrenal Gland Cytology</b> .....	199
Qing Kay Li	
<b>9 Urine Cytology</b> .....	221
Madelyn Lew	
<b>10 Serous Effusion Cytology</b> .....	235
Qing Kay Li	
<b>11 Lymph Node Cytology</b> .....	259
Von G. Samedi and Qian-Yun Zhang	
<b>Index</b> .....	289

---

## Contributors

**Derek B. Allison, M.D.** Department of Pathology, The Johns Hopkins Medical Institutions, Baltimore, MD, USA

**David Borzik, M.D.** Department of Pathology, The Johns Hopkins Medical Institutions, Baltimore, MD, USA

**Yun Gong, M.D.** Department of Pathology and Laboratory Medicine, The University of Texas MD Anderson Cancer Center, Houston, TX, USA

**Xin Jing, M.D.** Department of Pathology, The University of Michigan Medicine, Ann Arbor, MI, USA

**Madelyn Lew, M.D.** Department of Pathology, University of Michigan, Ann Arbor, MI, USA

**Qing Kay Li, M.D., Ph.D., F.C.A.P.** Department of Pathology and Oncology, The Johns Hopkins Medical Institutions, Baltimore, MD, USA

**Aatika Malik, M.D.** Department of Pathology and Laboratory Medicine, Temple University Lewis Katz School of Medicine, Philadelphia, PA, USA

**Gabriela Oprea-Ilies, M.D.** Department of Pathology, Emory University School of Medicine, Atlanta, GA, USA

**Judy Pang, M.D.** Department of Pathology, The University of Michigan, Ann Arbor, MI, USA

**Von G. Samed, M.D., Ph.D.** Department of Pathology, University of New Mexico Hospital, Albuquerque, NM, USA

**Andrew Sciallis, M.D.** Department of Pathology, University of Michigan, Ann Arbor, MI, USA

**Momin T. Siddiqui, M.D., F.I.A.C.** Department of Pathology and Laboratory Medicine, Weill Cornell Medicine, New York, NY, USA

**He Wang, M.D., Ph.D.** Department of Pathology and Laboratory Medicine, Robert Wood Johnson Medical School of Rutgers University, New Brunswick, NJ, USA

**Qian-Yun Zhang, M.D., Ph.D.** Department of Pathology, University of New Mexico Hospital, Albuquerque, NM, USA