

# Foreword to the Second Edition

This book comes at an opportune time when breast ultrasound examinations are increasing on a worldwide basis due to the availability of high-resolution imaging systems and the realization that ultrasound provides valuable information by differentiating between early cancers and benign lesions with a high degree of accuracy. Ultrasound is also the method of choice for interventional procedures, and plays an important role in patient management. In addition, the concept that ultrasound may have a role in "screening" for breast cancers in selected women will lead to an increase in examination numbers and require a better understanding of the potential of ultrasound imaging systems.

The text of this second edition has been completely revised to bring it up to date with current ACR BI-RADS ultrasound terminology, and, where required, images have been replaced to better illustrate the features described by the ultrasound lexicon. This makes the book suitable for clinicians in all countries and ensures that all descriptors are in accordance with the standard terminology.

Dr. Helmut Madjar and Dr. Ellen B. Mendelson are recognized international breast disease experts. They bring with them the clinical acumen and teaching experience to guarantee that the

book not only meets the requirements for advanced breast imagers to optimize their skills in breast ultrasound but also fulfills the needs of beginners with little knowledge of the modality.

Dr. Madjar's ultrasonic skills in breast disease diagnosis, together with his long-term surgical experience, provide a distinctive insight into breast anatomy and pathology, which results in a clear understanding of the correlation between the disease processes and the associated feature descriptors.

Dr. Mendelson has made significant contributions to the book by introducing her knowledge and experience gained in chairing the ACR BI-RADS Ultrasound Expert Working Group responsible for the development of the ultrasound lexicon. Dr. Mendelson's devotion and commitment to high-quality breast imaging is reflected by her international reputation, and by bringing her experience to the book, its value as a comprehensive text has been greatly enhanced.

This book contains the material required to achieve high standards of examination and reporting, and is essential reading to ensure that the best results are obtained for all patients.

*Jack Jellins*

*Founding President—IBUS*

# Foreword to the First Edition

The use of ultrasound for examining individuals presenting with breast problems has increased significantly in recent years. Attempts to delineate changes in breast tissue prior to intervention have become an essential part of modern clinical management. The goal is to avoid breast operations in women with benign lesions while also avoiding the dissemination of malignant cells that would compromise the chance for a cure. Recent advances in technology have facilitated the production of high-quality studies. High-resolution ultrasound images can be obtained in a specific area of interest within the breast volume, and if desired the whole breast can be quickly assessed by following a suitable scanning protocol.

Dr. Helmut Madjar has worked in the field of breast disease diagnosis and treatment since the early 1980s. By developing a systematic scanning protocol, he has contributed significantly to breast ultrasound by extending the capabilities of two-dimensional image interpretation. More recently, Dr. Madjar has further extended the capabilities of ultrasound techniques by evaluating the role of blood flow in the breast and analyzing pathologic features with a view to expanding the traditional criteria for ultrasound interpretation. Dr. Madjar's surgical experience, his expertise in mammography and pathology, and his years of work in various professional societies qualify him to produce a textbook on breast ultrasound which meets the guidelines of the German Society for Ultrasound in Medicine (DEGUM), the International Breast Ultrasound School (IBUS), and the German Union of Health Care Fund Physicians.

This book is structured to comply with the requirements of a three-tiered course of instruction in breast ultrasound covering material at the "basic," "intermediate," and "advanced" levels. It presents a range of diverse breast pathologies that will train the reader to recognize the critical features necessary for making a diagnosis. The inclusion of a standardized reporting format at the intermediate level facilitates the documentation of critical ultrasonic features and ensures that all essential features are included in the description of the area under investigation. This book will significantly improve the reader's ability to interpret breast ultrasound images, and it will provide a basis for the more effective utilization of the ultrasound modality.

Dr. Madjar's extensive experience in continuing education at national and international levels has established his reputation as a leading authority in breast ultrasound. His position as Seminar Director of DEGUM, President of the International Association for Breast Ultrasound (IABU), and Vice-President of IBUS make this clear.

The scientific and clinical results that Dr. Madjar has accumulated in his own research activities also help to make this book a valuable tool for all clinicians and sonologists interested in expanding the clinical capabilities of ultrasonic breast imaging.

*Sydney, Australia  
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*Jack Jellins  
President—IBUS*

# Preface

Ultrasound imaging of the breast has changed dramatically in recent years owing to advances in technology. In the 1970s and early 1980s, the indications for breast ultrasound were limited to palpable nodules and the differentiation of cystic and solid masses. Contrast resolution and spatial resolution at that time were relatively poor, consequently there was a limited capacity for soft-tissue discrimination and the detection of small lesions. Ultrasound technology has advanced significantly in recent years. In the late 1980s, 5-MHz transducers were considered state of the art. Today it is suggested that broad bandwidth linear transducers up to 17–5 MHz or 15–8 MHz with center frequencies of 7–8 MHz or higher be used. Considerable research has been conducted to develop spatial compounding, a speckle-reducing method that improves image quality, currently available in many high-end systems with high-resolution transducers used for breast imaging. Volume acquisitions, multiplanar reconstructions, and 3D/4D technology are available for existing and future applications.

Worldwide randomized controlled trial studies have shown that early detection of breast cancer is important and that mammography screening can reduce breast cancer mortality by 20–40%. These and other studies have also confirmed that high fibroglandular density can limit mammography's sensitivity and that adjunctive screening techniques can help to surmount this problem. Advances in handheld ultrasound have promoted confidence in differentiating between benign and malignant solid masses. Alongside this, there has been increased research interest in the potential of ultrasound for use in evaluating the breasts of women with newly diagnosed breast cancer for extent of the malignant process, as well as for additional screening of women whose risk of breast cancer is high and whose breasts are of high fibroglandular density on mammograms.

With the exception of skin cancers, breast cancer is the most common malignant disease in women of North America and Europe. The risk increases with aging and, as is currently thought, also with breast density, which is higher in younger women. Around 20–30% of breast cancers will develop prior to menopause. A positive family history, especially in first-degree premenopausal relatives, increases the breast cancer risk, and women with genetic mutations such as BRCA-1 and BRCA-2 have an estimated 70–80% risk of developing the disease. Many of these women develop breast cancer at an early age, underscoring the need for an intensive and technically optimal screening program that minimizes the effect of breast density.

In 2007, the American Cancer Society announced its new screening recommendations for contrast-enhanced breast MRI to be

performed on an annual basis, in addition to (not replacing) mammography, for women with genetic mutations. Although research is being conducted in newer modalities that might be unaffected by breast density, such as positron emission and 99Tc sestamibi scanning using high-resolution cameras tailored for breast imaging, ultrasound is a leading contender for adjunctive screening of women of high risk (but not as high as that conferred by genetic mutation, previous mantle radiation to the chest for Hodgkin disease, or biopsy with histology of lobular carcinoma in situ) and with radiographically dense breast tissue. Technologic advances, including work on automated scanners, the development of standardized equipment specifications, improved education and training, an optimized examination technique, and data from multicenter studies such as ACRIN (American College of Radiology Imaging Network) 6666 are necessary to support the use of ultrasound for the detection of clinically and mammographically occult disease. Although its efficacy and cost-effectiveness in screening await confirmation from multicenter trial data, breast ultrasound has had a long, well-established history as a diagnostic modality. Use of ultrasound in evaluating palpable masses and breast thickening as well as lesions identified or suspected on mammograms has become the standard of care, helping to increase diagnostic specificity.

Owing to its superficial position, the breast is excellently suited for ultrasound evaluation. Nevertheless, the heterogeneous nature of the component breast tissues requires an examiner who has a basic understanding of ultrasound physics and acoustic artifacts, outlined in the first chapter. Also important for optimizing the power of ultrasound in both detection and diagnosis of breast abnormalities is recognition of breast anatomy and physiologic changes, which are addressed in the opening chapters of this text.

The German Federal Union of Health Insurance Fund Physicians (KBV) established guidelines for accreditation in breast ultrasound based either on in-clinic training or a specialized course of instruction. The latter involves a three-tiered program consisting of a basic, intermediate, and advanced course. This program also requires 200 examinations to be conducted under qualified supervision. The accreditation program represents a minimum requirement, and experienced examiners have realized that their proficiency would grow if they performed the examinations with attention to proper technique.

The format of this book, which was first published in German in 1999 and in English in 2000 with the second German edition appearing in 2005, is based on the progressive course levels of the KBV program and the training guidelines of the German Soci-

ety for Ultrasound in Medicine (DEGUM) and is in accordance with all published international standards. It starts with basic technical principles, examination technique, the sonographic anatomy of the normal breast, and an outline of the examination protocol. Next, the intermediate course presents a systematic approach to the interpretation of specific benign and malignant breast lesions. Finally, the advanced course deals with specialized or evolving areas such as screening, surgical planning, the evaluation of microcalcifications, and interventional ultrasound, which covers ultrasound-guided fine-needle aspiration and core and vacuum-assisted biopsy techniques, the ultrasound-guided preoperative localization of nonpalpable lesions, and specimen ultrasonography for confirming the complete removal of small focal lesions. The book concludes with a review of innovative techniques that have made significant strides in recent years: 2D image reconstruction, 3D ultrasound imaging, and Doppler ultrasound techniques with and without contrast agents.

The second English edition has been revised to include North American practice patterns, similar in large measure but different in some respects from those of Germany presented in the first edition. Throughout the world, within the past 15 years and even longer, ultrasound has become an integral part of diagnostic breast evaluations, imaging-guided interventions, and patient management plans. The indications for breast sonography as well as the technical standards outlined in this text are in accord with those of

the American College of Radiology (ACR), which also has accreditation programs for breast sonography and ultrasound-guided interventions similar to those of European organizations such as the German Society for Ultrasound in Medicine (Deutsche Gesellschaft für Ultraschall in der Medizin: DEGUM). Added to this edition, helping to strengthen the role of ultrasound in the management of breast disease and offering the basis for self-audit of breast sonologists, is the presentation of the ACR's BI-RADS (Breast Imaging Reporting and Data System) for ultrasound, one of three multimodality lexicons based on a feature analytic approach used in standardizing description, reporting, and lesion assessment. The existence of these programs attests to the importance of ultrasound in managing breast lesions as well as to the commitment of breast imagers worldwide to do their very best in early detection and diagnosis of breast cancer.

Our format is intended to make it easy for the novice to learn about breast ultrasound, but it is also designed to provide a quick and practical reference for the experienced, practicing sonologist. The goal of the book is to help standardize the examination technique and the interpretation of findings, and thus to elevate the status of breast ultrasound as a diagnostic modality. We hope you will find this text useful, reach for it often, and enjoy reading it.

*Helmut Madjar*  
*Ellen B. Mendelson*

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by the Atlantic Ocean and many time zones. Our special thanks also to the entire Thieme team involved in producing this text, which we hope will be useful to breast imagers everywhere.