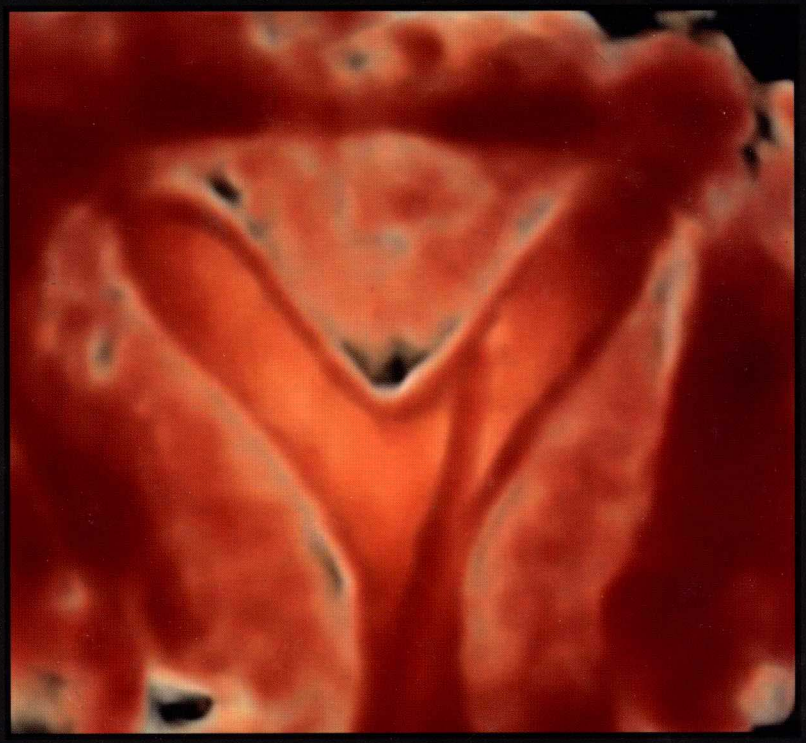
Benacerraf • Goldstein • Groszmann

GYNECOLOGIC ULTRASOUND

A Problem-Based Approach



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A Problem-Based Approach

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This book is dedicated to my husband, Peter Libby, who gave me love, encouragement, inspiration, and support throughout my life; and to my children, Oliver and Brigitte Libby, who make me proud and complete my life.

Beryl Benacerraf

This book is dedicated to the late Robert F. Porges, MD, who believed in me when some others didn't and gave me the opportunity to prove I "could," and it is dedicated as well to the very-much-alive Wendy J. Sarasohn, who has connected to the part of me now able to see the "rainbows."

Steven Goldstein

I would like to dedicate this to my parents, Dr. Roberto Groszmann and Aida Groszmann, for giving me a wonderful life. Additionally, I would like to thank David Sella, my lifelong friend and talented photographer. Lastly, I need to thank Dr. Beryl Benacerraf. She is a brilliant physician and a wonderful colleague, and I am lucky to call her my mentor.

Yvette Groszmann

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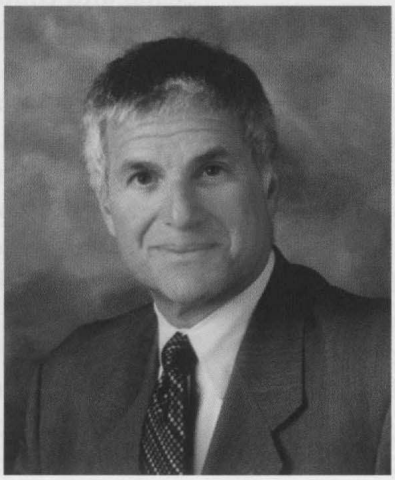
Beryl R. Benacerraf



Steven R. Goldstein

Yvette S. Groszmann

Receiving her MD in 1976 from Harvard Medical School, **Beryl R. Benacerraf** went on to complete her internship at Peter Bent Brigham Hospital, her residency at Massachusetts General Hospital, and her fellowship in ultrasound and computed tomography at Brigham and Women's Hospital. During her 34-year academic affiliation with Harvard Medical School, she has risen to the rank of clinical professor in obstetrics, gynecology, and reproductive biology and radiology. From 1991 through 1993, Dr. Benacerraf was co-director of high-risk obstetric ultrasound at Brigham and Women's Hospital, and from 1993 through 1999 she was director of the obstetric ultrasound unit at Massachusetts General Hospital.

Active in the ultrasound community, Dr. Benacerraf has directed and organized a host of postgraduate ultrasound courses. Among her many roles in the ultrasound community, she is an elected fellow of the American College of Radiology and the Society of Radiologists in Ultrasound, was treasurer of the World Federation for Ultrasound in Medicine and Biology for 7 years, is the current president-elect of the American Institute of Ultrasound in Medicine, and is a board member of the International Society of Ultrasound in Obstetrics and Gynecology. Dr. Benacerraf is also the medical director and president of Diagnostic Ultrasound Associates, PC, a medical practice that she founded in 1982. She served as Editor in Chief of the *Journal of Ultrasound in Medicine* from 2000 to 2010. Her contributions to the field of diagnostic ultrasound have been recognized by the Ian Donald Gold Medal of the International Society of Ultrasound in Obstetrics and Gynecology, the Frye Award, and the Holmes award (both from the American Institute of Ultrasound). She was selected to deliver the Silver Lecture at Barnard College in 2007, and she received the 2008 Marie Curie Award from the Association of Women Radiologists. In 2010, she was the recipient of the Larry Mack award for lifetime achievement in ultrasound research from the Society of Radiologists in Ultrasound.

Having authored more than 260 peer-reviewed articles, she has focused her research on the detection and significance of fetal anomalies. Dr. Benacerraf did the original research that linked nuchal thickening directly to an increased risk for fetal Down

syndrome and developed the genetic sonogram, both of which have changed the way all pregnant women are currently screened for fetal Down syndrome. She has also made important contributions to the implementation of 3-D ultrasound in both obstetrics and gynecology. She has contributed chapters to many textbooks in the field and is the sole author of *Ultrasound of Fetal Syndromes,* recently published in its second edition. More recently, she has taken a special interest in ultrasound of gynecologic patients, in particular those with chronic pelvic pain.

Steven R. Goldstein, MD, is a Magna Cum Laude graduate of Colgate University with a Baccalaureate degree in Biology. He graduated from the New York University School of Medicine and did an internship in Obstetrics and Gynecology at Parkland Memorial Hospital in Dallas, Texas. He did a residency in Obstetrics and Gynecology at New York University Affiliated Hospitals/ Bellevue Hospital Center. Thereafter he joined the faculty of the Department of Obstetrics and Gynecology at New York University School of Medicine, rising to his current rank of Professor of Obstetrics and Gynecology, a tenured full-time academic position. However, in this capacity, he maintains a half-time private practice as a generalist in Obstetrics and Gynecology in the Faculty Practice suites at New York University.

His longstanding interests in OB-GYN ultrasound have led him to his current position as Director of Gynecologic Ultrasound at New York University Medical Center. He is a Fellow of the American Institute of Ultrasound in Medicine and is currently President of this national organization. He is a past President of the North American Menopause Society. He served on the Board of Directors of the American Registry of Diagnostic Medical Sonographers, having prepared the test and administered policy for the certification of over 40,000 sonographers nationwide. He is a past Chairman of the American College of Obstetrics and Gynecology, New York section. He was author of their Technical Bulletin *Ultrasound in Gynecology* as well as the author of their practice guidelines on SERMs (selective estrogen receptor modulators). He serves as the liaison physician from the American College of Obstetrics and Gynecology to the Women's Health Imaging Panel of the American College of Radiology. He has been an examiner for the American Board of Obstetrics and Gynecology.

His pioneering work in menopausal and perimenopausal ultrasound led him into design of uterine safety studies for several Selective Estrogen Receptor Modulators. In addition he is the Co-Director of the Bone Densitometry Unit at NYU Langone Medical Center. Clinically, his practice has evolved into issues of menopausal and perimenopausal medicine with particular interest in ultrasound applications for both adnexal masses and abnormal bleeding.

He has authored textbooks titled *Endovaginal Ultrasound* and *Ultrasound in Gynecology*. More recently, he authored *Imaging in the Infertile Couple* and *Textbook of Perimenopausal Gynecology*. He is one of the most highly recognized and regarded individuals in the field of vaginal probe ultrasound worldwide. He has authored more than 60 chapters in textbooks and more than 80 original research articles. He has been a guest faculty member, invited speaker, visiting professor, or course director more than 400 times throughout the United States and the world.

Dr. Goldstein has a long history as an adviser and consultant to the pharmaceutical industry. He has been on gynecologic advisory boards and/or consulted for Amgen, Bayer, Boehringer Ingelheim, Eli Lilly, Merck, GlaxoSmithKline, Novo Nordisk, Wyeth, Procter & Gamble, Warner Chilcott, Shionogi, QuatRx, Depomed, and Pfizer. He has represented Eli Lilly, Pfizer, and Mirabilis Medica in their appearances before FDA Advisory Boards. He has designed studies of uterine safety for Eli Lilly, Wyeth, Pfizer, and GlaxoSmithKline. He holds two patents in the medical device arena. He was director of a publicly traded ultrasound company, SonoSite, Inc., from its inception until its sale to Fuji Medical in 2012.

He resides in New York City.

Yvette S. Groszmann attended Tufts University and graduated with a BS in Biopsychology. She obtained her medical degree in 2000 from the University of Connecticut, as well as a Master's in Public Health. She then completed a residency in Obstetrics and Gynecology at Pennsylvania Hospital in Philadelphia. Her residency training emphasized the importance of ultrasound as part of the routine practice of obstetrics and gynecology. As a result, she received considerable training and practice in ultrasound during her time at Pennsylvania Hospital. After completing her formal training, she joined a multispecialty medical group in Boston as a full-time

obstetrician-gynecologist with hospital appointments at Brigham and Women's Hospital and Faulkner Hospital. In 2009, Dr. Groszmann left her practice as a generalist to do a fellowship in diagnostic ultrasound under the guidance of Dr. Beryl Benacerraf. She joined Diagnostic Ultrasound Associates in 2010 and continues her affiliation with Brigham and Women's Hospital. Dr. Groszmann enjoys teaching, and she received a teaching award during residency. She is currently a clinical instructor at Harvard Medical School and teaches gynecologic ultrasound to the OB-GYN residents.

Dr. Groszmann is a fellow of the American College of Obstetrics and Gynecology and a member of the American Institute of Ultrasound in Medicine. She is board certified in Obstetrics and Gynecology.

Preface

This book is designed for the clinician as a practical approach to problem-solving for gynecologic patients. The book provides a stepwise and convenient guide to the diagnosis of gynecologic abnormalities for practitioners providing gynecologic care.

The book is organized by a listing of symptoms or findings that a practitioner might encounter when evaluating a patient sonographically (in the Contents section called *List of Differential Diagnoses*). These categories include a variety of topics, including pelvic pain, pelvic masses, and postmenopausal bleeding. Under each category, there is a list of differential diagnostic possibilities. For example, within pelvic pain, the differential diagnoses include appendicitis, ectopic pregnancy, hemorrhagic cyst, degenerating fibroid, and so on. The reader can select or refer to the specific disease or entity to go into a "mini-chapter" (there are 54 of these) and read more about that particular entity and its sonographic appearance, as well as review images illustrating it.

The 54 mini-chapters focus on each entity or diagnosis (such as hemorrhagic cyst, fibroid, or polyps) and contain abundant images (more than 600) from several patients to give comprehensive examples of the sonographic and Doppler findings for each of these findings or disease states. Each mini-chapter is arranged in a standard format that includes Synonyms/Description, Etiology, Ultrasound Findings, Differential Diagnosis, Clinical Aspects and Recommendations, and Suggested Reading. There is also a chapter on the normal ultrasound examination of the female pelvis, followed by a series of 26 test cases of abnormalities for readers to see what they have learned.

This book is not a standard textbook on gynecologic ultrasound, of which there are many excellent offerings. Most of these textbooks are constructed with separate chapters for each organ (such as the uterus, ovary, and fallopian tubes). Rather, this book is intended as a reference focused on problem solving. A clinician can consult the book to look up a specific symptom or finding and help narrow down the differential diagnoses to one correct entity.

This book is intended for radiologists, obstetricians/gynecologists, infertility specialists, emergency physicians, sonographers, and residents in OB-GYN and radiology who perform pelvic ultrasound. The book may also be useful to primary care physicians, nurse practitioners, physician's assistants, and other personnel who see patients with pelvic symptoms and order the imaging. The diagnoses are presented by symptom, differential diagnosis, and alphabetically for easy searching.

It is hoped that this book will give practitioners who take care of women with pelvic complaints a practical reference that will be useful in solving their diagnostic dilemmas.

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Endometriosis of the uterus or myometrium

Etiology

Adenomyosis is defined pathologically when endometrial glands and stroma are found in the myometrium, distant from the endometrial cavity itself. This ectopic endometrial tissue has the ability to induce hypertrophy of the surrounding myometrium. This process can be focal or diffuse and thus accounts for the variability in the ultrasound appearances noted. The endometrium-myometrium junctional zone is jagged and fuzzy because the endometrial mucosa essentially invades the underlying myometrium, thus blurring the interface between these two, typically distinct zones. (This may be focal or global.)

Ultrasound Findings

Generalized Adenomyosis

The uterus is typically enlarged and globular with heterogeneous myometrium, which is typically wider on one side than the other. The heterogeneous myometrium often contains myometrial cysts, which likely represent areas of glandular dilatation or hemorrhage caused by repeated bleeding. These cysts are also frequently seen in a subendometrial location.

Adenomyoma

An adenomyoma appears as a focal, somewhat circumscribed island of heterogeneity in the myometrium, suggesting a fibroid, but typically without clear borders. When the borders are sharp, one cannot distinguish an adenomyoma from a fibroid. The adenomyoma may project into the cavity in the form of a broad-based polyp (polypoid adenomyoma).

Three-dimensional (3-D) ultrasound is helpful to demonstrate the multitude of linear hyperechoic bands emanating from the endometrium into the myometrium, producing the shaggy outline of the endometrial cavity on 3-D coronal view of the uterus.

Although magnetic resonance imaging (MRI) has been useful for diagnosing adenomyosis, it is unnecessary because ultrasound has similar accuracy. A comparison between ultrasound and MRI was reported using 23 articles (involving 2312 women). Transvaginal ultrasound had a sensitivity and specificity of 72% and 81%, respectively, whereas MRI had a sensitivity and specificity of 77% and 89%, respectively.

Doppler evaluation of adenomyosis usually does not add to the diagnosis because the amount of vascularity is variable and nonspecific.

Differential Diagnosis

If the area of adenomyosis is focal, it may be confused with a fibroid or a polyp if it projects into the endometrial cavity. Because of the lucencies and heterogeneities in the myometrium, uterine malignancy (though very rare) is sometimes considered. The clue to the correct diagnosis is the asymmetry of the width of the myometrium comparing the posterior to the anterior aspect on longitudinal view as well as the shaggy appearance of the endometrial echo in a patient with chronic pain and abnormal bleeding.

Clinical Aspects and Recommendations

Historically, heavy menstrual bleeding (menorrhagia) and painful menstruation (dysmenorrhea) are the major symptoms of adenomyosis and are said to occur in approximately 60% and 25% of women, respectively. It has also been implicated in some cases of chronic pelvic pain. In the past, symptoms typically developed in women in the fourth and fifth decade of life (perimenopausally); however, this probably reflects the fact that in the past the diagnosis of adenomyosis historically was made at the time of hysterectomy and not with sophisticated