

Ultrasonography in Reproductive Medicine and Infertility

Cambridge University Press
978-0-521-50976-3 - Ultrasonography in Reproductive Medicine and Infertility
Edited by Botros R. M. B. Rizk
Frontmatter
[More information](#)

Ultrasonography in Reproductive Medicine and Infertility

Edited by

Botros R. M. B. Rizk

Professor and Head, Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, and Medical and Scientific Director of USA IVF Program, University of South Alabama, Mobile, Alabama, USA

Cambridge University Press
978-0-521-50976-3 - Ultrasonography in Reproductive Medicine and Infertility
Edited by Botros R. M. B. Rizk
Frontmatter
[More information](#)

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town,
Singapore, São Paulo, Delhi, Dubai, Tokyo

Cambridge University Press
The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by
Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521509763

© Cambridge University Press 2010

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2010

Printed in the United Kingdom at the University Press, Cambridge

A catalogue record for this publication is available from the British Library

ISBN 978-0-521-50976-3 Hardback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party Internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

Every effort has been made in preparing this publication to provide accurate and up-to-date information which is in accord with accepted standards and practice at the time of publication. Although case histories are drawn from actual cases, every effort has been made to disguise the identities of the individuals involved. Nevertheless, the authors, editors and publishers can make no warranties that the information contained herein is totally free from error, not least because clinical standards are constantly changing through research and regulation. The authors, editors and publishers therefore disclaim all liability for direct or consequential damages resulting from the use of material contained in this publication. Readers are strongly advised to pay careful attention to information provided by the manufacturer of any drugs or equipment that they plan to use.

This book is dedicated to my very dear wife and life partner Mary for her love, support and sacrifice and to my children Christopher, Christine, David, and Danielle who inspire me every morning.

Contents

List of contributors page ix
Foreword xiii
 Ronald Franks
Preface xv
 Botros Rizk
Acknowledgments xvi

Section 1: Imaging techniques

1 **The future of imaging and assisted reproduction** 1
 Alan H. DeCherney and Micah J. Hill

2 **Ultrasonography: physics and principles** 11
 Osama M. Azmy and Kareem El-Nahas

3 **Hysterosalpingography** 22
 Shawky Z. A. Badawy, Stuart J. Singer and Amr Etman

4 **Fertiloscopy** 34
 Antoine Watrelot

5 **Sonohysterography** 42
 William W. Brown, III

6 **Diagnostic hysteroscopy** 54
 Tony Bazi and Tony G. Zreik

7 **Ethics of ultrasonography** 64
 Osama M. Azmy and Kareem El-Nahas

Section 2: Ultrasonography in infertility

8 **3D Ultrasonography and infertility** 67
 Jose M. Puente and Juan A. Garcia-Velasco

9 **Ultrasonography and diagnosis of polycystic ovary syndrome** 75
 Manubai Nagamani and Rebecca Chilvers

10 **Ultrasonography and the treatment of infertility in polycystic ovary syndrome** 81
 Carolyn J. Alexander

11 **Ultrasonography of uterine fibroids** 87
 Angela Clough and Yakoub Khalaf

12 **Ultrasonography of the endometrium** 97
 Richard Palmer Dickey

13 **Ultrasonography of the cervix** 103
 Mona Aboulghar and Botros Rizk

14 **Color Doppler imaging of ovulation induction** 113
 Osama M. Azmy and Alaa El-Ebrashy

15 **Ultrasonography of pelvic endometriosis** 119
 Juan A. Garcia-Velasco, Maria Cerrillo and Lia Ornat

16 **Adenomyosis** 126
 Edward A. Lyons

17 **Congenital uterine malformations** 134
 Mona Aboulghar

18 **Uterine septum** 141
 Mohamed F. M. Mitwally and Mostafa Abuzeid

19 **Ultrasonography and incidental ovarian pathology** 155
 Dimitrios Siassakos, Valentine Akande and Luciano G. Nardo

20 **Scrotal ultrasonography in male infertility** 163
 Nabil Aziz and Iwan Lewis-Jones

21 **Transrectal ultrasonography in male infertility** 171
 Levent Gurkan, Andrew C. Harbin and Wayne J. G. Hellstrom

22 **Ultrasonographic evaluation of acute pelvic pain** 176
 Aimee Eyvazzadeh and Deborah Levine

23 **Ultrasonographic evaluation of chronic pelvic pain** 187
 Nicole Brooks and Moshood Olatinwo

Section 3: Ultrasonography in assisted reproduction

24 **Ultrasonography and IVF** 193
 Luciano G. Nardo and Tarek A. Gelbaya

Contents

- | | | | |
|--|---|--------------|--|
| 25 | Ultrasonography and hydrosalpinges in IVF 202
Annika Strandell and Seth Granberg | 32 | Heterotopic pregnancy and assisted reproduction 271
Samuel F. Marcus, Essam S. Dimitry, Maria Dimitry, Diana M. Marcus and Botros Rizk |
| 26 | Ultrasonographic evaluation of ovarian reserve 213
Timur Gurgan, Aygul Demiroglu and Suleyman Guven | 33 | Cervical pregnancy 276
Hany F. Moustafa, Botros Rizk, Nicole Brooks, Brad Steffler, Susan L. Baker and Elizabeth Puscheck |
| 27 | Ultrasonography in oocyte retrieval for IVF 220
Matts Wikland and Lars Hamberger | 34 | Congenital anomalies and assisted reproductive technologies 283
Mona Aboulghar |
| 28 | Ultrasonography-guided embryo transfer: evidence-based practice 225
Gautam N. Allahbadia | 35 | Multiple pregnancy following IVF 291
James Hole, Kathy B. Porter, Sherri K. Taylor, Vicki Arguello, Robin Brown, Tiffany Driver and Willie Cotten |
| 29 | Ultrasonography-guided embryo transfer: clinical experience 234
Mostafa Abuzeid and Botros Rizk | 36 | Ultrasonography in the prediction and management of ovarian hyperstimulation syndrome 299
Botros Rizk, Christopher B. Rizk, Mary G. Nawar, Juan A. Garcia-Velasco and Hassan N. Sallam |
| Section 4: Early pregnancy after infertility treatment | | | |
| 30 | First-trimester pregnancy failure 251
William W. Brown, III | | |
| 31 | Ectopic pregnancy 259
Botros Rizk, Mostafa Abuzeid, Christine B. Rizk, Sheri Owens, John C. LaFleur and Youssef Simaika | | |
| | | <i>Index</i> | 313 |

Contributors

Mona Aboulghar, MD, MBCH

Assistant Professor, Department of Obstetrics and Gynecology, Cairo University; IVF Consultant, The Egyptian IVF Center, Maadi, Cairo, Egypt

Mostafa Abuzeid, MD, FACOG, FRCOG

Director of the Division of Reproductive Endocrinology, Department of Obstetrics and Gynecology, Hurley Medical Center, Flint, Michigan; Practice Director, IVF Michigan, Rochester Hills, Michigan; Professor, Department of Obstetrics and Gynecology, Michigan State University College of Human Medicine, East Lansing, Michigan, USA

Valentine Akande, PhD, MRCOG

Consultant Obstetrician and Gynecologist, Bristol Centre for Reproductive Medicine and Division of Women's Health, Southmead Hospital, Bristol, United Kingdom

Carolyn J. Alexander, MD

Associate Residency Program Director, Division of Reproductive Endocrinology and Infertility; Assistant Professor, David Geffen School of Medicine at UCLA, Department of Obstetrics and Gynecology, Cedars-Sinai Medical Center, Los Angeles, California, USA

Gautam N. Allahbadia, MD, DNB, FNAMS, FCPS, DGO, DFP, FICMU, FICOG

Medical Director, Deccan Fertility Clinic and Keyhole Surgery Center, Rotunda – The Center for Human Reproduction, Mumbai, India

Vicki Arguello, RDMS

Senior Ultrasonographer, Department of Obstetrics and Gynecology, University of South Alabama Mobile, Alabama, USA

Nabil Aziz, MB ChB, MRCOG, MD

Consultant in Gynecology and Reproductive Medicine, Liverpool Women's Hospital and The University of Liverpool, Liverpool, United Kingdom

Osama M. Azmy, MD

Professor of Reproductive Health, National Research Center, Cairo, Egypt

Shawky Z. A. Badawy, MD, EACOG

Professor and Chair, Department of Obstetrics and Gynecology, State University of New York, Upstate Medical University, Syracuse, New York, USA

Susan L. Baker, MD, FACOG

Associate Professor, Division of Maternal and Fetal Medicine, Department of Obstetrics and Gynecology Department, University of South Alabama, Mobile, Alabama, USA

Tony Bazi, MD

Assistant Professor, Department of Obstetrics and Gynecology, American University of Beirut Medical Center, Beirut, Lebanon

Nicole Brooks, DO, FACOG

Assistant Professor, Assistant residency Program Director, Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA

Robin Brown, RDMS

Senior Ultrasonographer, Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA

William W. Brown, III, MD

Director, Ambulatory Obstetrics and Gynecology, Denver Community Health Services; Assistant Professor, Department of Obstetrics and Gynecology, University of Colorado School of Medicine, Colorado, USA

Maria Cerrillo

IVI Madrid, Rey Juan Carlos University, Madrid, Spain

Rebecca Chilvers, MD

Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, University of Texas Medical Branch, Galveston, Texas, USA

Angela Clough

Senior Ultrasonographer, Guy's and St Thomas' Hospital Assisted Conception Unit, London, United Kingdom

Willie Cotten, RDMS

Ultrasonographer, Department of Obstetrics and Gynecology, University of South Alabama Mobile, Alabama, USA

List of contributors

Alan H. DeCherney, MD

Branch Chief of Reproductive Biology and Medicine Branch, National Institute of Child Health & Human Development, Bethesda, Maryland, USA

Aygul Demiroglu, MD

Associate Professor, Medical Director, Gurgan Clinic Women's Health, Infertility and IVF Center, Ankara, Turkey

Richard Palmer Dickey, MD, PhD, FACOG

Clinical Professor and Chief, Section of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, Louisiana State University, New Orleans, Louisiana; Medical Director, The Fertility Institute of New Orleans, Mandeville, Louisiana, USA

Essam S. Dimitry, MBBCh, FRCOG, MPhil

Consultant Gynecologist, Heatherwood Hospital, Ascot, United Kingdom

Maria Dimitry, MBBS, BSc

Lister Hospital, Stevenage, United Kingdom

Tiffany Driver, RDMS

Ultrasonographer, Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA

Alaa El-Ebrashy, MD

Professor of Obstetrics and Gynecology, Assistant Director of Fetal Medicine Unit, Cairo University, Cairo, Egypt

Kareem El-Nahas, MSc

Research Fellow of Reproductive Health, Reproductive Health Research Department, National Research Center, Cairo, Egypt

Amr Etman, MD

Department of Obstetrics and Gynecology, Upstate Medical University, Syracuse, New York, USA

Aimee Eyvazzadeh, MD, MPH

Department of Obstetrics and Gynecology, University of Michigan, Ann Arbor, Michigan, USA

Juan A. Garcia-Velasco, MD

Vice President for Scientific Affairs, University of South Alabama, Alabama, USA; Director, IVI Madrid, Assistant Professor of Obstetrics and Gynecology, Rey Juan Carlos University, Madrid, Spain

Tarek A. Gelbaya, MD

Department of Reproductive Medicine, St. Mary's Hospital, Manchester, United Kingdom

Seth Granberg, MD

Professor, Department of Obstetrics and Gynecology, Akershus University Hospital, Lørenskog, Norway

Timur Gurgan, MD

Professor and Chief, Division of Reproductive Medicine and Infertility, Department of Obstetrics and Gynecology, Faculty of Medicine, Hacettepe University, Ankara, Turkey

Levent Gurkan, MD

Department of Urology, Universal Hospitals Group, Istanbul, Turkey

Suleyman Guven, MD

Associate Professor, Department of Obstetrics and Gynecology, School of Medicine, Karadeniz Technical University, Trabzon, Turkey

Lars Hamberger, MD, PhD, FRCOG

Professor, Department of Obstetrics and Gynecology, University of Gothenburg, University of Gothenburg, Gothenburg, Sweden

Andrew C. Harbin, MD

Department of Urology, Tulane University School of Medicine, New Orleans, Louisiana, USA

Wayne J. G. Hellstrom, MD, FACS

Professor, Department of Urology, Tulane University School of Medicine, New Orleans, Louisiana, USA

Micah J. Hill, DO

Eunice Kennedy Shriver National Institute of Child Health and Human Development, Program in Reproductive and Adult Endocrinology, Bethesda, Maryland, USA

James Hole, DO

Assistant Professor, Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA; Director of Antenatal Testing, Wellspan Maternal-Fetal-Medicine; Assistant Clinical Professor of OB/GYN, Penn State University College of Medicine, Hershey, Pennsylvania, USA

Yakoub Khalaf MSc, MD, MRCOG

Consultant and Senior Lecturer in Reproductive Medicine and Surgery; Medical Director, The Assisted Conception Unit, Guy's and St Thomas' Hospital Foundation Trust, London, United Kingdom

John C. LaFleur, MD

Assistant Professor, Assistant Clerkship Director, Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA

Deborah Levine, MD

Associate Chief of Academic Affairs, Departments of Radiology and Obstetrics and Gynecology, Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA

Iwan Lewis-Jones, MB ChB, MD

Consultant Andrologist, Liverpool Women's Hospital, Liverpool, United Kingdom

Edward A. Lyons, OC, FRCP(C), FACR

Professor of Radiology, Obstetrics and Gynecology and Anatomy, University of Manitoba, Canada; President, Canadian Association of Radiologists, Manitoba, Canada

Diana M. Marcus, MD

Department of Obstetrics and Gynecology, University College Hospital, London, United Kingdom

Samuel F. Marcus, MD, FRCS, FRCOG

Consultant of Obstetrics and Gynecology, Lead Clinician Fertility Services, Queen Elizabeth Hospital, London, United Kingdom

Mohamed F. M. Mitwally, MD, HCLD, FACOG

Reproductive Endocrinologist, TCART, Toronto, Canada; President CAREM (Canadian American Reproductive Medicine Incorp), Windsor, Ontario, Canada

Hany F. Moustafa, MD

Research Fellow, Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA

Manubai Nagamani, MD

Professor and Division Chief, Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, University of Texas Medical Branch, Galveston, Texas, USA

Luciano G. Nardo, MD

Consultant in Reproductive Medicine and Surgery, Department of Reproductive Medicine Manchester, United Kingdom

Mary G. Nawar, MD, MRCOph

Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA

Moshood Olatinwo, MD

Assistant Professor, Department of Obstetrics and Gynecology, University of South Alabama Mobile, Alabama, USA

Lia Ornat, MD

IVI Madrid, Rey Juan Carlos University, Madrid, Spain

Sheri Owens, MD

Assistant Professor and Clerkship Director, Department of Obstetrics and Gynecology, University of South Alabama, Mobile, Alabama, USA

Kathy B. Porter, MD, MBA

Professor and Chair, Department of Obstetrics and Gynecology; Director, Division of Maternal fetal Medicine, University of South Alabama, Mobile, Alabama, USA

Jose M. Puente, MD

IVI Madrid, Rey Juan Carlos University, Madrid, Spain

Elizabeth Puscheck, MD, FACOG

Professor, Director of IVF, Director of Gynecologic Ultrasonography, Division of Reproductive Endocrinology and Infertility, Wayne State University, Detroit, Michigan, USA

Botros Rizk, MD, MA, FRCOG, FRCS(C), HCLD, FACOG, FACS

Professor and Head, Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, Medical and Scientific Director of USA IVF Program, University of South Alabama, Mobile, Alabama, USA

Christine B. Rizk

John Emory Scholar, Emory University, Atlanta, Georgia, USA

Christopher B. Rizk

Rice University, Houston, Texas, USA

Hassan N. Sallam, MD, FRCOG, PhD

Director, The Suzanne Mubarak Regional Centre for Women's Health and Development; Professor and Chair, Department of Obstetrics and Gynecology, Director of Research in the Faculty of Medicine, University of Alexandria, Alexandria, Egypt

Dimitrios Siassakos MSc DLSHTM, MRCOG

Division of Women's Health, Southmead Hospital, Bristol, United Kingdom

Youssef Simaika, MRCOG

Consultant Gynecologist, Coptic Hospital, Cairo, Egypt

Stuart J. Singer, MD

Division of Interventional Radiology, Department of Radiology, Syracuse, New York, USA

Brad Steffler, MD

Associate Professor, Chief of Interventional Radiology, Department of Radiology, University of South Alabama, Mobile, Alabama, USA

Annika Strandell, MD, PhD

Associate Professor, Department of Obstetrics and Gynecology, University of Gothenburg, Gothenburg, Sweden

Sherri K. Taylor, MD

Assistant Professor, Department of Obstetrics and Gynecology, University of South Alabama Mobile, Alabama, USA

Antoine Watrelot, MD

Centre de Recherche et d'Etude de la Stérilité (CRES), Le Britannia-20, Boulevard Eugène Deruelle, Lyon, France

Matts Wikland, MD, PhD

Fertility Centre Scandinavia, Carlanders Hospital, Gothenburg, Sweden

Tony G. Zreik, MD, MBA

Associate Professor, Department of Obstetrics and Gynecology, Lebanese American University School of Medicine, Beirut, Lebanon; Clinical Assistant Professor, Department of Obstetrics and Gynecology and Reproductive Sciences, Yale University School of Medicine, New Haven, Connecticut, USA

Foreword

In his third book, Dr. Botros Rizk has assembled a comprehensive overview of ultrasonography's multiple uses in reproductive medicine. It stresses the recent advances in ultrasonography, in particular its improved image clarity, and its impact on the success of gynecologists and urologists in the treatment of infertility and reproductive failure. A select group of international experts provides a very practical, clinically relevant guide to the diagnostic use of ultrasonography in unraveling the complex clinical conditions that prevent conception. With depth and precision, this book will be of substantial benefit to the generalist as well as the subspecialist engaged in the assessment and treatment of such patients. Written in an easily understood style with frequent clinical examples, the reader will return again and again to this volume for invaluable assistance in the effective use of ultrasonography in the treatment of reproductive failure.

Ronald Franks

Preface

Ultrasonography is both an art and a science that the authors and readers of this book practice and enjoy every day. This ultrasonography book is written for every gynecologist, infertility specialist, ultrasonographer and radiologist who perform ultrasonography daily in the pursuit of precise diagnoses and planned management.

The practice and development of reproductive medicine have been revolutionized by advances in gynecological ultrasonography. In fact, evaluation of male and female infertility has been redefined by the use of ultrasonography and the practice of assisted reproductive technology (ART) has been reinvented. Ultrasound images for every gynecological disease or abnormality encountered during the reproductive years are at your fingertips in this book, which is written by an international group of authorities and leaders of gynecological ultrasound from four continents and eleven countries. The authors have compiled hundreds of original ultrasound images to enrich your experience.

The book has a simple layout in four sections. The first section covers the different imaging techniques such as sonohysterography and hysterosalpingography. The physics of ultrasound as well as the principles of Doppler are clearly explained.

The second section covers most aspects of female and male infertility; common gynecological diseases such as endometriosis, adenomyosis, uterine fibroids and polycystic ovary syndrome are elegantly captured in a series of original images. Male infertility is described in two chapters addressing scrotal and transrectal ultrasonography. Acute and chronic pelvic pain are visualized in a series of cases that are readily imprinted in readers' minds. The third section takes the reader through in vitro fertilization (IVF) step by step. The optimization processes prior to IVF of assessment of the ovarian reserve and hydrosalpinges are also described. The use of ultrasonography for oocyte retrieval and embryo transfer are illustrated in an extensive series of ultrasound images. The final section deals with pregnancy after infertility treatment. It highlights pregnancy failures in the first trimester as well as the variety of ectopic pregnancies encountered. The congenital anomalies after IVF have attracted the attention of both the media and the obstetrician and are elegantly demonstrated. Finally, the most common and serious complications of IVF, namely multiple pregnancies and ovarian hyperstimulation syndrome, are covered in the concluding chapters.

I sincerely wish you, our readers, an enjoyable book that enhances your personal expertise every day.

Acknowledgments

It is a special pleasure to give thanks to whom thanks are due. My interest in ultrasonography started when I shadowed my mother, Dr. Isis Mahrous Rofail, in her gynecology office in Cairo, Egypt in the early 1980s. Every time we performed an ultrasound of a uterine fibroid or a pelvic mass, it complimented clinical acumen. During the first year of my residency in England, I had the greatest pleasure of working with Dr. Dudley Mathews. As the most senior consultant, he took it upon himself to see the majority of patients to allow me to spend time with my patients and to learn how to perform ultrasound well. That year was the most exciting of the last 25 years. During my fellowship in London – training under Professor Robert Edwards, an icon in physiology and reproduction, and Professor Stuart Campbell, an icon in ultrasound and gynecology – each day brought new and exciting discoveries. Professor Campbell opened the floodgates for new ideas in ultrasonography and every month brought in a new ultrasound machine to test. He pioneered transabdominal ultrasound oocyte retrieval, which replaced laparoscopic oocyte retrieval as had been established by the late Patrick Steptoe. When I moved to Alabama years later, I was pleasantly surprised to find that my former

mentor in London, Professor Campbell, had initiated advanced ultrasonography in Obstetrics and Gynecology there on the invitation of our Former Chair of Gynecology, Dr. Hiram W. Mendenhall. Dr. Mendenhall had learnt advanced sonography under Professor Campbell at Kings College Hospital London. Our Unit has been a leader in the field since that time.

A special thanks go to every one of our ultrasonographers who have contributed to the images in this book: Vicki Arguello, Robin Brown, Tiffany Driver, Willie Cotten, Lucy Baldwin, Shelley Zimbleman, and Amy Bower. I am very indebted to Mr. Nick Dunton, the senior acquisition editor of Cambridge University Press, for the skill with which he has addressed every stage and to Nisha Doshi, Katy James and Rachael Lazenby for their outstanding production of a highly illustrated book.

Botros Rizk, MD, MA, FRCOG, FRCS(C), HCLD, FACOG,
FACS Professor and Head, Reproductive Endocrinology
and Infertility, Department of Obstetrics and Gynecology,
University of South Alabama, Alabama