

# Maternal Hemodynamics





# Maternal Hemodynamics

Edited by

**Christoph Lees** 

Imperial College, London

Wilfried Gyselaers

Hasselt University, Diepenbeek, Belgium





## **CAMBRIDGE**UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom One Liberty Plaza, 20th Floor, New York, NY 10006, USA 477 Williamstown Road, Port Melbourne, VIC 3207, Australia 4843/24, 2nd Floor, Ansari Road, Daryaganj, Delhi – 110002, India

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org Information on this title: www.cambridge.org/9781107157378 DOI: 10.1017/9781316661925

© Cambridge University Press 2018

79 Anson Road, #06-04/06, Singapore 079906

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 2018

Printed in the United Kingdom by TJ International Ltd. Padstow Cornwall

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

Library of Congress Cataloging-in-Publication Data

Names: Lees, Christoph, editor. | Gyselaers, Wilfried, 1963– editor.

Title: Maternal hemodynamics / edited by Christoph Lees, Wilfried Gyselaers.

Description: Cambridge, United Kingdom; New York, NY: Cambridge University Press, 2018. | Includes bibliographical references.

Identifiers: LCCN 2017045274 | ISBN 9781107157378 (hardback)

Subjects: | MESH: Pregnancy Complications, Cardiovascular | Hemodynamics | Hypertension,

Subjects: | MESH: Pregnancy Complications, Cardiovascular | Hemodynamics | Hypertension, Pregnancy-Induced | Pre-Eclampsia | Plasma Volume | Fetal Growth Retardation – etiology Classification: LCC RG580.H9 | NLM WQ 244 | DDC 618.3/6132–dc23 LC record available at https://lccn.loc.gov/2017045274

ISBN 978-1-107-15737-8 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 book to provide accurate and up-to-date information that 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 book. Readers are strongly advised to pay careful attention to information provided by the manufacturer of any drugs or equipment that they plan to use.



## **Contents**

List of Contributors vii

# Section 1 — Physiology of Normal Pregnancy

- 1 Maternal Hemodynamics in Health and Disease: A Paradigm Shift in the Causation of Placental Syndromes 1 Baskaran Thilaganathan
- Cardiovascular and Volume
   Regulatory Functions in Pregnancy:
   An Overview 13
   Louis Peeters
- 3 Cardiac Function 24
   Herbert Valensise, Gian Paolo Novelli,
   Daniele Farsetti and Barbara Vasapollo
- The Venous Compartment in Normal Pregnancy 34
   Kathleen Tomsin and Wilfried Gyselaers
- 5 The Microcirculation 42 Jérôme Cornette and Andreas Brückmann
- Plasma Volume Changes in
   Pregnancy 58
   Marc E. A. Spaanderman and Anneleen
   S. Staelens

### Section 2 — Pathological Pregnancy: Screening and Established Disease

 7 Arterial Function in Pathological Pregnancies 69
 Asma Khalil and Silvia Salvi

- 8 Cardiac Dysfunction in Hypertensive Pregnancy 79
   Herbert Valensise, Gian Paolo Novelli and Barbara Vasapollo
- 9 Dysfunction of the Venous System
   Before and During
   Preeclampsia 86
   Sharona Vonck and Wilfried Gyselaers
- 10 Microvascular Findings in Pathological Pregnancy 91 Andreas Brückmann and Jérôme Cornette

## Section 3 — Techniques: How To Do

- 11 How to Assess Arterial
  Function? 101
  Helen Perry, Carmel McEniery and
  Asma Khalil
- 12 How to Do a Maternal VenousDoppler Assessment 113Wilfried Gyselaers
- Noninvasive Techniques for Measuring Cardiac Output During Pregnancy 120
   Victoria L. Meah, Eric J. Stöhr and John R. Cockcroft
- Techniques of Measuring Plasma
   Volume Changes in Pregnancy
   Anneleen Staelens and Marc
   Spaanderman

V



vi

Contents

## Section 4 — Cardiovascular Therapies

- 15 Treatment Options for Hypertension in Pregnancy 141Lin Fung Foo, Jasmine Tay and Ian Wilkinson
- 16 **Aspirin** 161 Shireen Meher
- 17 Vascular Endothelial Growth Factor Gene Therapy in the Management of Cardiovascular Problems in Pregnancy 171 Yuval Ginsberg and Anna David
- Nitric Oxide Donors in
   Preeclampsia 181
   Thomas Everett, Taminrit Johal and Christoph Lees
- 19 Vasodilatation and Fluid
   Expansion 193
   Herbert Valensise, Damiano Lo Presti
   and Marc Spaanderman

#### Section 5 — Controversies

- 20 Beyond Temporal Classification of Early and Late Preeclampsia 205 Enrico Ferrazzi, Daniela Di Martino, Tamara Stampalija and Maria Muggiasca
- 21 Chemotherapy and CardiovascularFunction in Pregnancy 219Kristel van Calsteren
- Maternal Cardiovascular Disease
   After Pregnancy
   Complications 229
   Johannes J. Duvekot

Index 249

Color plates are to be found between pp. 152 and 153



Contributors

#### Andreas Brückmann

Dept. of Obstetrics, University Hospital Jena, Friedrich-Schiller University, Germany

#### John R. Cockcroft

Dept. of Cardiology, University of Wales College of Medicine, Cardiff, United Kingdom

#### Jérôme Cornette

Dept. of Obstetrics, Erasmus Medical Centre Rotterdam, the Netherlands

#### Anna David

Institute for Women's Health, University College London, United Kingdom

#### Daniela Di Martino

Dept. of Obstetrics, Gynecology and Neonatology, ICP – Buzzi Childrens' Hospital, University of Milan, Italy

#### Johannes J. Duvekot

Dept. of Obstetrics, Erasmus Medical Centre Rotterdam, the Netherlands

#### Thomas R. Everett

Dept. of Fetal Medicine, Leeds General Infirmary, Leeds Teaching Hospitals NHS Trust, United Kingdom

#### **Daniele Farsetti**

Department of Obstetrics and Gynaecology, Policlinico Casilino, Tor Vergata University, Rome, Italy

#### Enrico Ferrazzi

Dept. of Obstetrics, Gynecology and Neonatolgy, ICP – Buzzi Childrens' Hospital, University of Milan, Italy

#### **Lin Fung Foo**

Dept. of Cancer and Surgery, Imperial College London, United Kingdom

#### Yuval Ginsberg

Institute for Women's Health, University College London, United Kingdom

#### Wilfried Gyselaers

Dept. of Physiology, Hasselt University, Diepenbeek, Belgium

#### **Taminrit Johal**

Dept. of Fetal Medicine, Rosie Hospital, Addenbrooke's Hospital, Cambridge University Hospitals, United Kingdom

#### Asma Khalil

Department of Fetal Medicine, St George's University of London, United Kingdom

#### **Christoph Lees**

Department of Surgery and Cancer, Imperial College London, United Kingdom

#### Carmel McEniery

Clinical Pharmacology Unit, University of Cambridge, United Kingdom

#### Damiano Lo Presti

Department of Obstetrics and Gynaecology, Policlinico Casilino, Tor Vergata University, Rome, Italy

#### Victoria L. Meah

Centre for Exercise and Health, Cardiff School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff, United Kingdom

vii



viii

**List of Contributors** 

#### Shireen Meher

Department of Obstetrics and Gynaecology, Birmingham Women's and Children's NHS Foundation Trust, Birmingham, United Kingdom

#### Maria Muggiasca

Dept. of Obstetrics, Gynecology and Neonatology, ICP – Buzzi Childrens' Hospital, University of Milan, Italy

#### Gian Paolo Novelli

Department of Cardiology, San Sebastiano Martire Hospital, Frascati, Rome, Italy

#### Louis L. Peeters

Dept. of Obstetrics, University Medical Centre Utrecht, the Netherlands

#### **Helen Perry**

Department of Fetal Medicine, St George's University of London, United Kingdom

#### Sylvia Salvi

Department of Fetal Medicine, St George's University of London, United Kingdom

#### Marc Spaanderman

Dept. of Obstetrics, University Medical Centre Maastricht, the Netherlands

#### **Anneleen Staelens**

Limburg Clinical Research Program, Hasselt University, Diepenbeek, Belgium

#### Tamara Stampalija

Dept. of Obstetrics, Gynecology and Neonatology, ICP – Buzzi Childrens' Hospital, University of Milan, Italy

#### Eric J. Stöhr

Columbia University Irving Medical Centre, Department of Medicine, Division of Cardiology, Columbia University, New York, USA

#### **Jasmine Tay**

Imperial College Healthcare NHS Trust, Queen Charlotte's & Chelsea Hospital, London, United Kingdom

#### Baskaran Thilaganathan

St George's University of London, St George's University Hospitals NHS Foundation Trust, London, United Kingdom

#### Kathleen Tomsin

Limburg Clinical Research Program, Hasselt University, Diepenbeek, Belgium

#### **Herbert Valensise**

Department of Obstetrics and Gynaecology, Policlinico Casilino, Tor Vergata University, Rome, Italy

#### Barbara Vasapollo

Department of Obstetrics and Gynaecology, Policlinico Casilino, Tor Vergata University, Rome, Italy

#### Kristel Van Calsteren

Dept. of Obstetrics and Gynecology, Catholic University Leuven, Belgium

#### **Sharona Vonck**

Limburg Clinical Research Program, Hasselt University, Diepenbeek, Belgium

#### Ian Wilkinson

Div. Experimental Medicine and Immunotherapeutics, University of Cambridge, United Kingdom