Assisted Reproductive Technology
Accomplishments and New Horizons

This insightful and thought-provoking book describes the many recent advances that have revolutionized reproductive medicine. This rapid transformation is the result of converging and overlapping developments in reproductive biology, molecular biology, and genetics, allied with remarkable developments in new technologies. This book surveys this rapid expansion and looks ahead at the exciting new prospects for the future that stand at the watershed between basic science and clinical application. From oogenesis and spermatogenesis, through to fertilization, embryogenesis and cloning, it looks at state-of-the-art technologies and scientific advances. Subsequent chapters focus on infertility and its diagnosis and treatment using the full armory of assisted reproductive technologies. A concluding section surveys the impact of these developments on the provision, regulation, and financing of reproductive health care in the global community.

This will be essential reading for all practitioners in reproductive medicine: scientists, clinicians and researchers.

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This book is dedicated to our families and in memory of the late Professor Lonnie Russell
## Contents

<table>
<thead>
<tr>
<th>List of contributors</th>
<th>ix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>xiii</td>
</tr>
</tbody>
</table>

### Part I  The gametes: present and future

<table>
<thead>
<tr>
<th>1</th>
<th>Spermatogenesis in vitro in mammals</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bernard Jégou, Charles Pineau, and Jorma Toppari</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The spermatozoon as a machine: compartmentalized pathways bridge cellular structure and function</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Alexander J. Travis and Gregory S. Kopf</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Attributes of fertile spermatozoa</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Christopher De Jonge and Christopher L. R. Barratt</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>In vitro oogenesis</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>Frank L. Barnes</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The oocyte as a machine</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Kate Hardy</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Follicular influences on oocyte and embryo competence</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Jonathan van Blerkom</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Unresolved and basic problems in assisted reproductive technology</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>Jim Cummins</td>
<td></td>
</tr>
</tbody>
</table>

### Part II  Techniques: present and future

<table>
<thead>
<tr>
<th>8</th>
<th>Influences of culture media on embryo development</th>
<th>127</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Barry Bavister and Jay Baltz</td>
<td></td>
</tr>
</tbody>
</table>
Contents

Part I The science

9 Cryopreservation of immature and mature gametes 144
   John K. Critser, Yuksel Agca, and Erik J. Woods
10 Embryonic stem cells 167
   Ann M. Lawler and John D. Gearhart
11 Modification of the male genome by gene and spermatogonial transplantation 178
   Peter J. Donovan, Michael D. Griswold, and the late Lonnie D. Russell
12 Genetic diagnosis: the future 186
   David Cram and David de Kretser
13 Cloning mammals 206
   Don P. Wolf and Shoukhrat Mitalipov
14 Fluorescence imaging: gamete selection and intracellular sperm injection 217
   Laura Hewitson, Cal Simerly, and Gerald Schatten

Part II Further development

15 Diagnosis and treatment of male infertility 231
   Axel Kamischke and Eberhard Nieschlag
16 Tests of male fertility 255
   R. John Aitken
17 Diagnosis and treatment for female subfertility 272
   Peter Platteau and Paul Devroe
18 Ultrasound imaging at the beginning of the second millennium 282
   Richard P. Dickey and Ellen Matulich
19 The natural and the stimulated cycle 302
   Ian D. Cooke

Part III The clinic

20 Embryo stage and transfer number 311
   Alan Trounson
21 The federal research base in the USA for assisted reproductive technology 320
   Donna L. Vogel

Part IV Concepts for the global community

22 From conception to contraception 329
   Gustavo F. Doncel, Christine Mauck, Douglas S. Colvard, and Lourens J. D. Zaneveld
23 Developing immunocontraceptives 355
   Eileen A. McLaughlin and Michael K. Holland
24 ARTistic licence: should assisted reproductive technologies be regulated? 366
   Nanette R. Elster
25 Finances and access to assisted reproductive technologies: justice and publication of results 376
   Francoise Shenfield
26 Sex selection 384
   Joe Leigh Simpson and Sandra Ann Carson
27 Intracytoplasmic sperm injection: a time bomb? 397
   Herman J. Tournaye and André C. Van Steirteghem
28 Cryopreservation of gametes and embryos: legal and ethical aspects 407
   Susan M. Avery and Peter R. Brinsden

Index 415

Plates between pp. 178 and 179*
*These plates are available for download in colour from www.cambridge.org/9780521188951
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Foreword

ART: today and beyond

Just think, prior to World War II, it was thought that the genetic message of our species was packaged in 48 chromosomes.

The 1950s saw what might be called the chromosomal revolution. In the early 1950s, I had a telephone call from Lawson Wilkins, Professor of Pediatrics at Johns Hopkins, who said that he had been at a medical meeting where an anatomist had indicated that it was possible to diagnose the sex of a cell and, therefore, of the individual, by examining a nerve cell under the microscope. Specifically, a large percentage of nuclei from females had a small unique granule or body. Lawson said “this was the damnest thing I ever heard.” He invited me to attend a meeting that afternoon with Dr. George Streeter, Director of the Carnegie Institute of Embryology, Dr. Carl Hartman, an eminent primatologist at the Institute, and the two of us to discuss this matter and see whether it had any clinical application. The result of this meeting was that it was decided that skin biopsies could be taken from several patients that Dr. Wilkins and I jointly had and who had problems of sexual differentiation. We reasoned that it might be possible, therefore, to make a nuclear sex determination of the individuals and to correlate that with the other criteria of sex identification. The amazing thing was that patients with Turner’s syndrome proved to be Barr body negative. Coincidentally, it had been the anatomist, Murray Barr, who had presented the paper that had intrigued Lawson Wilkins’ interest. Thus, we were forced to the conclusion that patients with Turner’s syndrome must have the Y chromosome.
However, a few years later, in 1956, Tjio and Levan showed that in the human there were but 46 chromosomes. Soon after that, in 1959, Charlie Ford showed that patients with Turner’s syndrome did not have XY sex chromosomes but were indeed characterized by having 45 chromosomes and only one sex chromosome, i.e., a single X. This was the same year that Lejeune had shown that patients with mongolism, later called Down syndrome, had an extra chromosome 21. By the end of the 1950s, clinical cytogenetics had become a reality.

On a parallel track, molecular genetics was having its own revolution. In 1953, Watson and Crick brought forth their blockbuster notion of the double helix. As a consequence, the concepts of Mendel, Garrod, and others acquired a molecular basis, with guanine, cytosine, thymine, and adenine becoming household words in homes tuned to the molecular age.

On still another track, another revolution was occurring. Chang, in 1958, using the rabbit, proved that a mammalian egg could be fertilized in vitro and develop into a normal rabbit. Twenty years later, Edwards and Steptoe achieved the first pregnancy in the human by what has come to be known clinically as in vitro fertilization (IVF).

The overall result is that in the early twenty-first century, all three of these revolutions are milling about in the same dish, that is the culture dish of the embryologist, who supervises on a more or less routine basis the union of the sperm and the egg by attractive forces that remain among nature’s mysteries.

While the clinician and the embryologist strive to get conditions just right to optimize the process of in vitro fertilization, it has now become possible to examine the chromosomes and indeed the molecular aspects of the genetic message along the way. It seems certain that, by the middle of the twenty-first century, the current diagnostic efforts will seem primitive indeed, but a beginning is being made in a very dynamic and rapidly moving field. It is possible to be comfortable in predicting that in due time therapy for chromosome and molecular abnormalities will be available to improve the human condition. Who could object to that?

Not to be forgotten is the fact that fertilization in vitro, with the gadgets to watch it and examine it along the way, has made all this possible. Furthermore, and most importantly, all these revolutions have taken place within the span of a single generation – clear evidence that we are not dealing with a mature discipline – on the contrary, we seem to be in the midst of an investigative whirlwind.

Therefore, the trinity of chromosomology, the molecular basis of genetics, and clinical IVF requires a “snapshot” from time to time so that all of those involved from the patient, and therefore the public, to the clinician and to the laboratory worker will know where we are and where we might go.

This is the eminently appropriate raison d’être for this snapshot – this book.

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