Trends in Andrology and Sexual Medicine
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Giancarlo Balercia · Loredana Gandini
Andrea Lenzi · Francesco Lombardo
Editors

Antioxidants in Andrology

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Trends in Andrology and Sexual Medicine

This series will serve as a comprehensive and authoritative resource that presents state of the art knowledge and practice within the fields of Andrology and Sexual Medicine, covering basic science and clinical and psychological aspects. Each volume will focus on a specific topic relating to reproductive or sexual health, such as male and female sexual disorders (from erectile dysfunction to vaginismus, and from hypoactive desire to ejaculatory disturbances), diagnostic issues in infertility and sexual dysfunction, and current and emerging therapies (from assisted reproduction techniques to testosterone supplementation, and from PDE5i to SSRIs for premature ejaculation). In addition, selected new topics not previously covered in a single monograph will be addressed, examples including male osteoporosis and the approach of traditional Chinese medicine to sexual medicine. Against the background of rapid progress in Andrology and Sexual Medicine, the series will meet the need of readers for detailed updates on new discoveries in physiology and pathophysiology and in the therapy of human sexual and reproductive disorders.

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Editors
Giancarlo Balercia
Endocrinology Department
Polytechnic University of Marche
Ancona
Italy

Loredana Gandini†
Department of Experimental Medicine
Section of Medical Pathophysiology
Sapienza University of Rome
Rome
Italy

Andrea Lenzi
Department of Experimental Medicine
Section of Medical Pathophysiology
Sapienza University of Rome
Rome
Italy

Francesco Lombardo
Department of Experimental Medicine
Section of Medical Pathophysiology
Sapienza University of Rome
Rome
Italy

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Dedication

Professor Loredana Gandini passed away because a sudden and dramatic disease on October 5, 2016, at the Umberto I General Hospital, in the same Sapienza University of Rome where she was an esteemed lecturer. Born in 1953 in the North of Italy, she obtained in 1980 the Degree in Biological Sciences and, four years later, the Degree of Specialist in General Pathology. At the end of her too short life, she was Full Professor of Clinical Pathology (since 2008) in the Sapienza University of Rome, Director of the Master in Andrology and Seminology, Director of the Complex Unit "Endocrine Diagnostics and Sperm Bank". Professor Gandini wrote a number of very well-cited full papers on international journals and more than 100 textbooks, manuals, book chapters, and monographs. She served as President of the Italian Society of Embryology, Reproduction and Research; Member of the Board of Directors of the Italian Society of Andrology and Sexual Medicine, and President of the Italian Society of Reproductive Pathophysiology.

Loredana Gandini was very active in the field of Endocrinology-Andrology, Reproductive Pathophysiology, and Immunology of Reproduction. She performed a constant and well-recognized effort to study, with modern techniques, the sperm physiology and male infertility. Most of the methods she developed have been transferred into the clinical setting.

She had always demonstrated her scientific and intellectual honesty both as Teacher and Scientist that did make her very well recognized in the field of Reproductive Medicine, Endocrinology and Embryology, and Andrology but also she had a wonderful smile that could light up a room.

This book is dedicated to Lori, as we affectionately called her, outstanding figure of scientist and our friend of a lifetime.

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Free Radicals in Andrology

1

Ashok Agarwal and Ahmad Majzoub

1.1 Introduction

Infertility is a condition associated with major medical and social preoccupation. A male etiology is responsible for nearly half the cases of infertility [1] and is caused by alterations in sperm concentration, motility, and/or morphology [2]. Recent advances in the field of infertility have greatly influenced our understanding of the different circumstances attributing to male factor infertility. While environmental, physiological, and genetic influences were recognized, at the molecular level, oxidative stress (OS) resulting from the imbalance between oxidants and reductants appears to be a common denominator impairing sperm function and delaying pregnancy.

Reactive oxygen species (ROS) are highly reactive oxidizing agents that can, at supraphysiological levels, have a potential toxic effect on sperm quality and function [3]. Like other free radicals, ROS contain unpaired electrons triggering a tendency for strong reactivity with other compounds. Moreover, they typically incite a chain reaction exposing a *vicious circle* type of activity. Under normal physiological circumstances, ROS are products of natural oxygen metabolism acting as vital signaling molecules. However, excessive levels of ROS can be

A. Agarwal, PhD, HCLD (✉)
American Center for Reproductive Medicine, Department of Urology, Cleveland Clinic, Cleveland, OH 44195, USA

Lerner College of Medicine, Andrology Center and American Center for Reproductive Medicine, 10681 Carnegie Avenue, Desk X11, Cleveland, OH 44195, USA
e-mail: agarwaa@ccf.org; http://www.ClevelandClinic.Org/ReproductiveResearchCenter

A. Majzoub, MD
American Center for Reproductive Medicine, Department of Urology, Cleveland Clinic, Cleveland, OH 44195, USA

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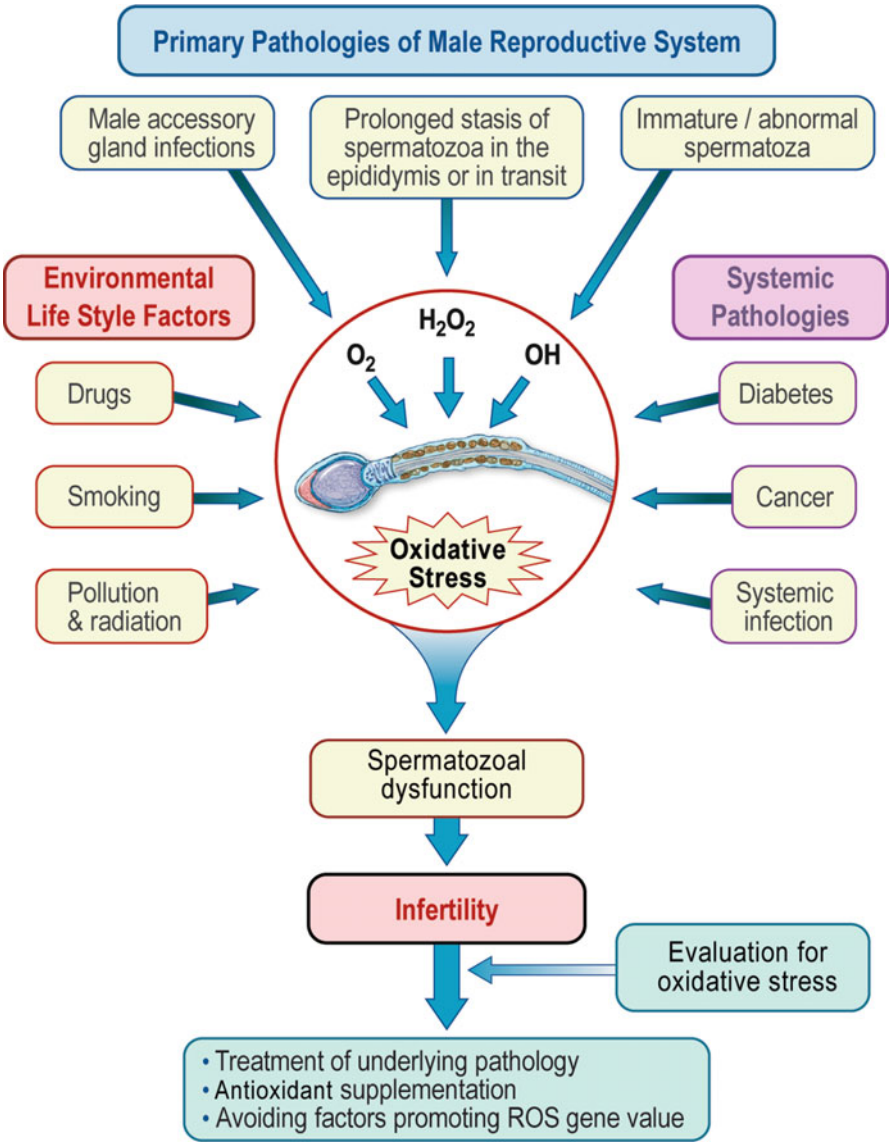

Fig. 1.1 Factors contributing to oxidative stress-induced male infertility (Copyright license provided)

produced secondary to a variety of environmental exposures and pathologic processes (Fig. 1.1) resulting in several disease entities such as neurodegenerative disease, vascular disease, cancer, and infertility. To minimize the hazardous effects of excessive ROS levels, a number of endogenous enzymatic and nonenzymatic antioxidants exist scavenging or neutralizing excess ROS.