Aging Medicine
Series Editors: Robert J. Pignolo · Mary Ann Forciea · Jerry C. Johnson

Robert J. Pignolo
Mary Ann Keenan
Nader M. Hebela *Editors*

Fractures in the Elderly

A Guide to Practical Management

Humana Press

Aging Medicine

Robert J. Pignolo, MD, PhD; Mary Ann Forciea, MD;
Jerry C. Johnson, MD, Series Editors

For other titles published in this series, go to
www.springer.com/series/7622

Robert J. Pignolo • Mary Ann Keenan
Nader M. Hebela
Editors

Fractures in the Elderly

A Guide to Practical Management

Humana Press

Editors
Robert J. Pignolo
Departments of Medicine and Orthopaedic Surgery
Director Ralston-Penn Clinic for Osteoporosis and Related Bone Disorders
University of Pennsylvania School of Medicine
Philadelphia, PA
USA
pignolo@mail.med.upenn.edu

Nader M. Hebela
Assistant Professor of Orthopaedic Surgery
Department of Orthopaedic Surgery
University of Pennsylvania School of Medicine
Philadelphia, PA
USA
nader.hebela@uphs.upenn.edu

Mary Ann Keenan
Professor, Department of Orthopaedic Surgery
Hospital of the University of Pennsylvania
Philadelphia, PA
USA
maryann.keenan@uphs.upenn.edu

ISBN 978-1-60327-466-1 e-ISBN 978-1-60327-467-8
DOI 10.1007/978-1-60327-467-8
Springer New York Dordrecht Heidelberg London

Printed on acid-free paper

Humana Press is part of Springer Science+Business Media (www.springer.com)

Preface

According to the National Osteoporosis Foundation, one in two women and one in four men over age 50 will have an osteoporosis-related fracture in their lifetime, accounting for more than 1.5 million fractures annually. In the USA, a women's risk of hip fracture is equal to her *combined* risk of breast, uterine, and ovarian cancer. Although not all fractures in the elderly are related to osteoporosis, the vast majority of them are, and the risk of fracture from both low- and high-impact trauma is increased in the setting of osteoporosis.

Only about 40% of hip fracture survivors are able to return to their prior level of activities of daily living, and even fewer return to their prefracture level for instrumental activities. A nontrivial proportion of patients with hip fractures will require long-term institutional care. Despite these sober statistics, currently less than 15% of those with recent fragility fractures are evaluated and treated for osteoporosis, dramatically increasing the likelihood of future fractures.

This book is an acknowledgement that fractures in the elderly are common, very often multifactorial, and are best approached by the collaborative efforts of orthopaedic surgeons and specialists in geriatric medicine. Other medical disciplines, including anesthesiology, rehabilitation medicine, psychiatry, endocrinology, and rheumatology also play key roles in the care of the elderly fracture patient. Because of the potentially devastating consequences of fractures in the elderly, their presentations should be viewed as opportunities to reduce future morbidity and mortality as well as to preserve function. This book is dedicated to these goals.

The specific aims of *Fractures in the Elderly* are (1) to provide geriatricians and other medical specialists who provide care for older adults with the necessary information and most current data and opinions regarding the treatment of elderly patients who sustain a variety of fractures, and (2) to provide orthopaedic surgeons with the necessary information and most current data and opinions regarding assessment and management of geriatric conditions that predispose the elderly to fracture, perioperative complications, and subsequent functional decline. The scope of the book will encompass the etiologies of fracture in the elderly, perioperative management, the surgical treatment of common fractures in the elderly, as well as rehabilitation and prevention in the older patient.

It was the intention of the editors to have the content of each chapter be both readable and appealing to both of the two major target audiences, as well as to all disciplines that have contact with elderly patients who have sustained or are at high risk of sustaining a fracture. We hope to illustrate that although in some cases pre- and postoperative care in elderly fracture patients may proceed as it does in younger individuals, often there are considerations owing to functional status, preexisting conditions, and age-related physiological declines that require specialized knowledge and alternative approaches. This book serves to provide this specialized knowledge and approaches to care, and it is intended to be a valuable reference for clinicians as well as fellows and residents in training.

Contents

Contributors

Jaimo Ahn
Assistant Professor, Department of Orthopaedic Surgery,
University of Pennsylvania School of Medicine, Philadelphia,
PA 19104, USA

Keith Baldwin, MD/MSPT/MPH
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania,
2 Silverstein Pavilion, 3400 Spruce Street, Philadelphia, PA 19104, USA

Karen Boselli, MD
Shoulder and Elbow Fellow, Department of Orthopaedic Surgery,
Columbia University, New York, NY 10032, USA

David J. Bozentka, MD
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania,
34th and Spruce Streets, 2nd Floor, Silverstein Building,
Philadelphia, PA 19104, USA
and
Department of Orthopaedic Surgery, Penn Presbyterian Medical Center,
Cupp 1, 39th and Market Streets, Philadelphia, PA 19104, USA

John Bruza, MD
Division of Geriatric Medicine, University of Pennsylvania School of Medicine,
3615 Chestnut Street, Philadelphia, PA 19104-2676, USA

Amy M. Corcoran, MD
Department of Medicine, Division of Geriatrics, University of Pennsylvania,
Penn-Ralston Center, 3615 Chestnut Street, Philadelphia, PA 19104, USA

Derek J. Donegan, MD
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania,
Philadelphia, PA 19104, USA

John L. Esterhai, MD
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania,
2 Silverstein, 3400 Spruce Street, Philadelphia, PA 19104, USA

Jonathan R. Gavrin, MD
Department of Anesthesiology and Critical Care, Department of Medicine, Hospital of the University of Pennsylvania, Dulles 6, 3400 Spruce Street, Philadelphia, PA 19104, USA

Albert O. Gee
Instructor, Department of Orthopaedic Surgery, University of Pennsylvania School of Medicine, Philadelphia, PA 19104, USA

Nader M. Hebela, MD
Department of Orthopaedic Surgery, University of Pennsylvania School of Medicine, Penn Presbyterian Medical Center, 1 Cupp Pavilion, 51 N 39th Street, Philadelphia, PA 19104, USA

G. Russell Huffman, MD/MPH
Department of Orthopaedic Surgery, University of Pennsylvania, 3400 Spruce Street, 2 Silverstein Pavilion, Philadelphia, PA 19104, USA

Jerry C. Johnson, MD
Division of Geriatric Medicine, Department of Medicine, University of Pennsylvania School of Medicine, 3615 Chestnut Street, Philadelphia, PA 19104-2676, USA

Atul F. Kamath, MD
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania, Philadelphia, PA 19104, USA

Mary Ann Keenan, MD
Professor, Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania, Philadelphia, PA 19104, USA

Jung-Hoon Kim, MD
University of Pennsylvania, Department of Medicine, Division of Geriatric Medicine, 3615 Chestnut Street, Ralston-Penn Center, Philadelphia, PA USA

Bruce Kinosian, MD
Associate Professor of Medicine, Department of Medicine, University of Pennsylvania Health System, Philadelphia, PA 19104, USA

Andrew F. Kuntz
Instructor, Department of Orthopaedic Surgery, University of Pennsylvania School of Medicine, Philadelphia, PA 19104, USA

Richard D. Lackman, MD
Department of Orthopaedic Surgery, Sarcoma Center of Excellence at the Abramson Cancer Center of the University of Pennsylvania, Hospital of the University of Pennsylvania, Philadelphia, PA 19104, USA

Gwo-Chin Lee, MD
Department of Orthopaedic Surgery, University of Pennsylvania,
3400 Spruce Street, 2 Silverstein Pavilion, Philadelphia, PA 19104, USA

Samir Mehta
Orthopedic Trauma and Fracture Service, Department of Orthopaedic Surgery,
Hospital of the University of Pennsylvania, Silverstein 2, 3400 Spruce Street,
Philadelphia, PA 19104, USA

J. Stuart Melvin, MD
Orthopaedic Trauma Fellow, Department of Orthopaedic Surgery,
Carolinas Medical Center, Charlotte, NC 28203, USA

Nick D. Pappas, MD
Department of Orthopaedic Surgery, Hospital of the University
of Pennsylvania, Philadelphia, PA 19104, USA

Robert J. Pignolo, MD/PhD
Departments of Medicine and Orthopaedic Surgery,
University of Pennsylvania School of Medicine, 424B Stemmler Hall,
36th Street and Hamilton Walk, Philadelphia, PA 19104-6081, USA

Kathleen Walsh Reyes, DO
Staff Physician, Jefferson Regional Medical Center
and University of Pittsburgh Medical Center,
Philadelphia PA, USA

Andrew Rosenzweig, MD
Staff Geriatrician and Internal Medicine Core Faculty Member,
Division of Geriatics and Department of Medicine, Abington Memorial Hospital,
Abington, PA 19001, USA;
Clinical Assisstant Professor of Medicine, Drexel University College of Medicine,
Philadelphia, PA 19102, USA

John Alan Scolaro, MD
Department of Orthopaedics, Hospital of the University of Pennsylvania,
Philadelphia, PA, USA

Jesse T. Torbert, MD, MS
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania,
Philadelphia PA, USA

Ejovi Ughwanogho, MD
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania,
Philadelphia, PA 19104, USA

Joan Weinryb, MD/CMD
Division of Geriatric Medicine, University of Pennsylvania Health System, Philadelphia, PA, USA

Laura C. Wiegand, MD
Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania, Philadelphia, PA 19104, USA

Part I
The Aging of Bone and Etiologies of Fractures

Chapter 1
Osteobiology of Aging

Andrew Rosenzweig and Robert J. Pignolo

Abstract The goals of this chapter will be to give a brief overview of bone biology, describe the molecular mechanisms of bone remodeling and pathologic uncoupling, and provide a general survey of the multiple pathways leading to aging bone and osteoporosis.

Keywords Bone • Remodeling • Osteoporosis • Osteoblast • Osteoclast • Cellular senescence

1.1 Introduction

The human skeleton is a dynamic organ that serves multiple functions including support, protection, storing metabolic building blocks, and providing insertion points for tendons and ligaments. A tightly coupled mechanism known as remodeling exists in the skeleton which allows for the constant turnover of bone, even after longitudinal growth has ceased. Osteoclasts reabsorb old bone and osteoblasts follow closely, laying down new structural units of bone. There is a complex interplay between these cells mediated by many endogenous local and systemic factors as well as exogenous mechanical stresses [1]. Peak bone mass usually occurs in the third decade of life in humans after which there is a period of relatively stable bone mass followed by progressive decline. As the body ages, the mechanism of bone remodeling becomes more dysfunctional, leading to an uncoupling of bone formation and resorption and a net loss of bone density and structural integrity, causing osteoporosis and increasing the risk of fractures.

R.J. Pignolo (✉)
Departments of Medicine and Orthopaedic Surgery, University of Pennsylvania School of Medicine, 424B Stemmler Hall, 36th Street and Hamilton Walk, Philadelphia, PA 19104-6081, USA
e-mail: pignolo@mail.med.upenn.edu

R.J. Pignolo et al. (eds.), *Fractures in the Elderly*, Aging Medicine,
DOI 10.1007/978-1-60327-467-8_1,