



Systematic Review

Metabolic Bone Disease in Children with Intestinal Failure and Long-Term Parenteral Nutrition: A Systematic Review

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Abstract: Metabolic bone disease (MBD) is a possible complication of intestinal failure (IF), with a multi-factorial pathogenesis. The reduction of bone density (BMD) may be radiologically evident before manifestation of clinical signs (bone pain, vertebral compression, and fractures). Diagnosis relies on dual-energy X-ray absorptiometry (DXA). Incidence and evolution of MBD are not homogeneously reported in children. The aim of this systematic review was to define the prevalence of MBD in IF children and to describe risk factors for its development. A comprehensive search of electronic bibliographic databases up to December 2021 was conducted. Randomized controlled trials; observational, cross-sectional, and retrospective studies; and case series published between 1970 and 2021 were included. Twenty observational studies (six case-control) were identified and mostly reported definitions of MBD based on DXA parameters. Although the prevalence and definition of MBD was largely heterogeneous, low BMD was found in up to 45% of IF children and correlated with age, growth failure, and specific IF etiologies. Data demonstrate that long-term follow-up with repeated DXA and calcium balance assessment is warranted in IF children even when PN dependence is resolved. Etiology and outcomes of MBD will be better defined by longitudinal prospective studies focused on prognosis and therapeutic perspectives.

Keywords: intestinal failure; short bowel; bone disease; bone density; osteoporosis; DXA; vitamin D; parenteral nutrition; calcium balance



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1. Introduction

Intestinal failure (IF) is the consequence of several gastrointestinal conditions that determine the necessity of parenteral nutrition (PN) to maintain adequate growth and fluids/energy balance [1]. Short bowel syndrome (SBS) is the principal cause of IF in children; more rarely, IF is the result of a congenital enteropathy or a severe motility disorder. SBS generally follows a bowel resection in the neonatal period for a gastrointestinal anomaly (atresia, gastroschisis, and omphalocele) or an acquired event (neonatal volvulus or necrotizing enterocolitis). More rarely, SBS can develop in older children because of a surgical resection for several conditions, including inflammatory bowel disease (IBD), volvulus, and ischemic events [2]. The reversibility of IF and the achievement of enteral autonomy depend on the underlying condition and the surgical outcomes but are also related to both nutritional and medical treatments. PN has a crucial role in the different phases of IF management; in fact, PN represents the mainstay of treatment in the very early phase of SBS, a medium-term solution in reversible IF cases (when the process of intestinal adaptation progressively encompasses the bowel loss), and a life-long strategy in the most severe forms of IF. Advancement in home PN (HPN) and enteral nutrition (EN), both in surgical techniques and in medical strategies and particularly the development of

Metabolic Bone Disease In Children

Salvador Castells, Laurence Finberg



Metabolic Bone Disease In Children:

Metabolic Bone Disease in Children Salvador Castells, Laurence Finberg, **Calcium and Bone Disorders in Children and Adolescents** Jeremy Allgrove, Nick Shaw, 2015 There has been a rapid expansion of knowledge in the field of paediatric calcium and bone disorders over the past twenty years. Advances have been made in the underlying genetic basis for many conditions in conjunction with progress in bone density and geometry imaging and the development of new treatment options. The 2nd revised edition of *Calcium and Bone Disorders in Children and Adolescents* presents up to date information on many aspects included in the 1st edition such as the physiology, pathology, diagnosis and management of numerous conditions including a chapter of case histories illustrating clinical aspects. New chapters on skeletal dysplasias, the genetics of osteoporosis, radiological imaging of bone and a practical approach to a child with recurrent fractures are included. Providing a comprehensive update, this book is a useful clinical resource for paediatricians and specialists in endocrinology, metabolic bone disease, nephrology, rheumatology, radiology, orthopaedics and clinical genetics who may be faced with a child with a calcium and/or bone disorder. *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism* Juliet E. Compston, Jane B. Lian, 2009-12-22 EDITOR IN CHIEF Clifford J. Rosen M.D. Maine Medical Center Research Institute Scarborough, Maine SENIOR ASSOCIATE EDITORS Juliet E. Compston M.D. FRCP University of Cambridge School of Clinical Medicine Cambridge United Kingdom Jane B. Lian Ph.D. University of Massachusetts Medical School Worcester Massachusetts This comprehensive yet concise handbook is an indispensable reference for the many clinicians who see patients with disorders of bone formation, metabolic bone diseases or disorders of stone formation. It is also a crucial tool for researchers, students and all other professionals working in the bone field. In a format designed for quick reference, it provides complete information on the symptoms, pathophysiology, diagnosis and treatment of all common and rare bone and mineral disorders. New in this edition: detailed coverage of osteonecrosis of the jaw; more in-depth coverage of cancer and bone including new approaches to pathogenesis, diagnosis and treatment; new approaches to anabolic therapy of osteoporosis; the latest research on Vitamin D; expanded coverage of international topics; more on the genetics of bone mass and newer imaging techniques for the skeleton. In addition, this edition features a free online-only appendix of medicines used to treat bone disorders and their availability around the world. *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism* John P. Bilezikian, 2024-12-05 For nearly 40 years, the *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism*, a publication of the American Society for Bone and Mineral Research (ASBMR), has been the leading comprehensive reference on bone and mineral health. In this fully revised 10th Edition, Dr. John P. Bilezikian and an expert editorial team of 34 global leaders and more than 300 contributing authors provide unsurpassed coverage of bone biology and bone diseases in a manner readily accessible to students, basic and clinical scientists and practitioners. *Metabolic Bone Disease in Children* Salvador Castells, Laurence Finberg, 1990 *Primer on the Metabolic Bone Diseases and Disorders*

of Mineral Metabolism, 2018-09-28 The authoritative reference to bone diseases and disorders of mineral metabolism revised and updated Now in its ninth edition The Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism offers an updated and comprehensive guide to bone and mineral health Since it was first published 30 years ago the Primer has become the leading reference on the topic With contributions from noted experts the text explores basic biological factors of healthy development and disease states and makes the information accessible for clinical interventions The ninth edition provides concise coverage of the widest possible spectrum of metabolic bone diseases and disorders of mineral metabolism The new edition of this invaluable reference expands coverage and includes the most recent developments in the field that help to strengthen its usefulness and ensure that the Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism maintains its place as the pre eminent reference on bone and mineral health This vital resource Provides the most accurate up to date evidence based information on basic and clinical bone science Includes more than 10 new chapters and contributions from 300 authors from wide ranging international research centers Captures the very cutting edge of research covering mineral homeostasis osteoporosis and other metabolic bone diseases skeletal measurement technologies and genetics Presents a new companion website with useful supplementary materials at www.asbmrprimer.com Written for advanced students clinicians and researchers working in the field of bone health and disease **The Bioarchaeology of Metabolic Bone Disease** Megan B. Brickley, Rachel Ives, Simon

Mays, 2020-07-30 The Bioarchaeology of Metabolic Bone Disease Second Edition is a comprehensive source dedicated to better understanding this group of conditions that have significant consequences for health in both past and present communities on a global scale This edition presents an updated introduction to the biology and metabolism of mineralised tissues that are fundamental to understanding the expression of the metabolic bone diseases in skeletal remains The extensive advances in understanding of these conditions in both bioarchaeological and biomedical work are brought together for the reader Dedicated chapters focussing on each disease emphasise the integration of up to date clinical background with the biological basis of disease progression to give guidance on identification New chapters covering anaemia and approaches to recognising the co occurrence of pathological conditions have been included reflecting recent advances in research Boxes highlighting significant issues use of information from sources such as texts and nonhuman primates and theoretical approaches are included in the text Each chapter closes with Core Concepts that summarise key information The final chapter reviews current challenges in bioarchaeology and provides directions for future research This is a must have resource for users at all career stages interested in integrating information on the metabolic bone diseases into bioarchaeological projects Covers deficiencies of vitamin C and D osteoporosis age related and secondary Paget s disease of bone anaemia and approaches to disease co occurrence Contains clear and user friendly guidance for macroscopic

radiological and microscopic diagnoses Highlights current inquiries and debates in biological anthropology bioarchaeology palaeopathology medical history and clinical biomedical research Extensive figures most new or updated provide invaluable information on biological processes and lesion expression through diagrams and photographs **Metabolic Bone Disease** Louis V. Avioli, Stephen M. Krane, 2013-09-11 Metabolic Bone Disease Volume II describes the clinical disorders of bone and mineral metabolism characterized by elevated levels of circulating parathyroid hormone This book emphasizes the relationship between hormonal synthesis biological activity and abnormalities in specific clinical syndromes The metabolism and structure function relationships of parathyroid hormone and other revealing interactions with specific receptors in target organs are also elaborated in this publication including a basis for some understanding of the parathyroid hormone and vitamin D resistant states Other topics discussed include the fundamental considerations of the physiology and biochemistry of parathyroid hormone pathogenesis of renal osteodystrophy and metabolic aspects of Paget's disease This publication also covers the effects of hypercalcemia and normocalcemic disorders of mineral metabolism This volume is beneficial to clinicians and students concerned with metabolic bone diseases *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism* Roger Bouillon, Juliet E. Compston, Vicki Rosen, 2013-06-11 Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism 8th Edition is the comprehensive revision of the field leading reference on bone and mineral health The eighth edition has been fully revised by the leading researchers and clinicians in the field to provide concise coverage of the widest possible spectrum of metabolic bone diseases and disorders of mineral metabolism Chapters look to explain basic biological factors of healthy development and disease states and make it easily translatable to clinical interventions Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism is the definitive one stop reference for anyone working in the field of bone health and disease Visit the companion site to access supplementary materials including videos editorial team details downloadable figures and more *Metabolic Bone Diseases—Advances in Research and Treatment: 2012 Edition*, 2012-12-26 Metabolic Bone Diseases Advances in Research and Treatment 2012 Edition is a ScholarlyBrief that delivers timely authoritative comprehensive and specialized information about Metabolic Bone Diseases in a concise format The editors have built Metabolic Bone Diseases Advances in Research and Treatment 2012 Edition on the vast information databases of ScholarlyNews You can expect the information about Metabolic Bone Diseases in this eBook to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of Metabolic Bone Diseases Advances in Research and Treatment 2012 Edition has been produced by the world's leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at <http://www.ScholarlyEditions.com> **Metabolic Bone Disease and Clinically Related Disorders** Louis V. Avioli, Stephen M.

Krane,1997-10-08 Metabolic Bone Disease Third Edition is the new expanded edition of the classic text featuring the latest advancements and research information in this fast moving field The Third Edition includes the most up to date information on molecular mechanisms basic biology pathophysiology and diagnosis and management strategies of metabolic bone disease Edited by fathers of the field An expanded version of a classic AP text Complete coverage of a fast growing field

Children's Orthopaedics and Fractures Michael Benson,John Fixsen,Malcolm Macnicol,Klausdieter Parsch,2010-03-10 Con rming the British genetic trait for writing and publishing as well as acting two English Oxford and London and a Scottish orthopaedic surgeon Edinburgh have produced a third edition of their comprehensive text joined as in the second edition by an editor from Germany recognizing its part in the European community The 62 physician contributors are drawn from pink colored countries in our childhood geography books the old British Empire from Australia to Zambia and two from the former colony the USA The original purpose of the book was to give residents or registrars an easily accessible and concise description of diseases and conditions encountered in the practice of paediatric orthopaedic surgery and to prepare for their examinations But the practicing orthopaedic s geon will nd an update of current practice that can be read for clarity and constraint enough but not too much A foreword might be a preview of things to come but a back word of what was thought to be the nal say on the subject is needed for a perspective in progress A back word look reveals the tremendous progress in medical diagnosis and treatment of which paediatric orthopaedics and fracture care is a component Clubfoot treatment based on the dictums of Hiram Kite has had a revolutionary change by Ponseti The chapter by Eastwood has the details on cast application and orthotics follow up to obtain the 95% correction without the extensive surgery many of us thought was needed

Imaging of Arthritis and Metabolic Bone Disease E-Book Barbara N. W. Weissman,2009-05-09 Get state of the art coverage of the full range of imaging techniques available to assist in the diagnosis and therapeutic management of rheumatic diseases Written by acknowledged experts in musculoskeletal imaging this richly illustrated full color text presents the latest diagnostic and disease monitoring modalities MRI CT ultrasonography nuclear medicine DXA as well as interventional procedures You ll find comprehensive coverage of specific rheumatic conditions including osteoarticular and extraarticular findings This superb new publication puts you at the forefront of imaging in arthritis and metabolic bone disease a must have reference for the clinician and imaging specialist Includes all imaging modalities relevant to rheumatic disease and applications and contraindications of each for balanced coverage Incorporates a user friendly consistent full color format for quick and easy reference Provides osteoarticular and extra articular features and findings to show how imaging benefits diagnosis and management of complex rheumatologic conditions Creates a one stop shop with comprehensive coverage of imaging for all rheumatic conditions including metabolic conditions and pediatric disorders Presents interventional techniques injections arthrography radiofrequency ablation to create the perfect diagnostic and interventional clinical tool

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