

# Endocrine and metabolic emergencies: hypocalcaemia

Richard Carroll and Glenn Matfin

**Abstract:** Hypocalcaemia is a common electrolyte disturbance, especially in the inpatient setting. There are a wide variety of causes of hypocalcaemia and correct management depends on the underlying diagnosis. However, acute hypocalcaemia is associated with significant morbidity and mortality and should be managed as a medical emergency. Chronic care of the hypocalcaemic patient is also briefly described, as this is an important opportunity to reduce further admissions related to both hypocalcaemic and hypercalcaemic presentations.

**Keywords:** hypocalcaemia, parathyroid hormone, vitamin D

## Introduction

Hypocalcaemia is a common electrolyte disturbance complicating approximately 26% of hospital admissions, and is found in as many as 88% of patients admitted to an intensive care unit (ICU) [Zivin *et al.* 2001]. There are a large number of recognized causes (see Table 1) and correct management depends on appropriate diagnosis [Matfin, 2009; Murphy and Williams, 2009]. Chronic hypocalcaemia may be asymptomatic even at low levels of serum calcium, but severe or acute hypocalcaemia is associated with predictable signs. Hypocalcaemia with neurological, muscular or cardiac dysfunction is associated with significant morbidity and mortality and should be managed as a medical emergency [Hästback and Pettilä, 2003].

## Pathophysiology

Calcium, phosphate and magnesium are the major divalent cations in the body [Matfin, 2009; Murphy and Williams, 2009; Selby, 2002]. They are ingested in the diet, absorbed from the intestine, filtered in the glomerulus of the kidney, reabsorbed in the renal tubules and eliminated in the urine. Only a small amount of these three ions is present in extracellular fluid (ECF). This small, but vital, amount of ECF calcium, phosphate and magnesium is directly or indirectly regulated by vitamin D and parathyroid hormone (PTH) [Matfin, 2009; Murphy and Williams, 2009; Selby, 2002].

Although classified as a vitamin, vitamin D functions as a hormone [Pearce and Cheetham, 2010; Matfin, 2009; Murphy and Williams, 2009; Whyte and Thakker, 2009; Selby, 2002]. It acts to sustain normal plasma levels of calcium and phosphate by increasing their absorption from the intestine, and is also necessary for normal bone formation. Vitamin D<sub>3</sub> is synthesized by ultraviolet irradiation of 7-dehydrocholesterol, which is present in the skin or obtained from foods in the diet, many of which are fortified with vitamin D. Once vitamin D enters the circulation from the skin or intestine, it is concentrated in the liver. There it is hydroxylated to form 25-hydroxyvitamin D<sub>3</sub> (25-(OH)D<sub>3</sub>). It is then transported to the kidney, where it is transformed into active 1,25-dihydroxyvitamin D<sub>3</sub> (1,25-(OH)<sub>2</sub>D<sub>3</sub>). The major action of the activated form of vitamin D, also called *calcitriol*, is to increase the absorption of calcium from the intestine. Calcitriol also sensitizes bone to the resorptive actions of PTH. There is also recent evidence that vitamin D controls parathyroid gland growth and suppresses the synthesis and secretion of PTH. The formation of 1,25-(OH)<sub>2</sub>D<sub>3</sub> in the kidneys is regulated in feedback fashion by plasma calcium and phosphate levels.

PTH, a major regulator of plasma calcium and phosphate, is secreted by the parathyroid glands. There are four parathyroid glands located on the dorsal surface of the thyroid gland. The dominant regulator of PTH is the plasma calcium

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# Metabolic And Endocrine Emergencies Baillieres Clinical Endocrinology Metabolism S

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**Cumulated Index Medicus** ,1988      **Medical and Health Care Books and Serials in Print** ,1986      *Whitaker's Book List* ,1991      **Metabolic and Endocrine Emergencies** Habeeb Bacchus,1984-01-01      **Subject Guide to Books in Print** ,1984      *Endocrine and Metabolic Emergencies* ,1980      Metabolic Syndrome Consequent to Endocrine Disorders V. Popovic,M. Korbonits,2018-04-05 Hormonal dysfunction can have a major and often complex impact on all key components of the metabolic syndrome This book comprises state of the art reviews on the subject written by recognized experts in the field of endocrinology Each chapter covers specific manifestations associated with the metabolic syndrome in classic endocrine diseases Compelling questions are highlighted and future directions presented The topics covered include hypopituitarism adrenal insufficiency acromegaly glucocorticoid excess androgen excess hypogonadism prolactin and thyroid and parathyroid hormone abnormalities This book is meant to inspire subsequent research related to metabolic complications in endocrine diseases thus enabling early detection as well as prompt and appropriate management      Endocrine Disrupting Chemicals-induced Metabolic Disorders and Treatment Strategies Muhammad Sajid Hamid Akash,Kanwal Rehman,Muhammad Zaffar Hashmi,2020-08-04 This volume offers a detailed and comprehensive analysis of Endocrine Disrupting Chemicals EDCs covering their occurrence exposure to humans and the mechanisms that lead to the pathogenesis of EDCs induced metabolic disorders The book is divided into three parts Part I describes the physiology of the human endocrine system with special emphasis on various types of metabolic disorders along with risk factors that are responsible for the development of these disorders Part II addresses all aspects of EDCs including their role in the induction of various risk factors that are responsible for the development of metabolic disorders Part III covers up to date environmental regulatory considerations and treatment strategies that have been adopted to cure and prevent EDCs induced metabolic disorders This section will primarily appeal to clinicians investigating the causes and treatment of metabolic disorders The text will also be of interest to students and researchers in the fields of Environmental Pharmacology and Toxicology Environmental Pollution Pharmaceutical Biochemistry Biotechnology and Drug Metabolism Pharmacokinetics

*Metabolic Syndrome* Rexford S. Ahima,2024-03-06 This comprehensive reference work presents an up to date survey of the current scientific understanding of the metabolic syndrome as well as an overview of the most significant advances in the field The book offers a thorough reference for obesity and the metabolic syndrome and will prove an indispensable resource for clinicians researchers and students The obesity epidemic has generated immense interest in recent years due to the wide ranging and significant adverse health and economic consequences that surround the problem Much attention has been focused on excessive consumption of energy dense food sedentary lifestyle and other behaviors that contribute to the pathogenesis of obesity However obesity is a highly complex condition that is influenced by genetic as well as environmental factors The metabolic syndrome comprises of central obesity hyperglycemia hypertension and dyslipidemia The incidence of

metabolic syndrome is growing worldwide affecting more than one third of adults in some countries The metabolic syndrome increases the risk of developing coronary artery disease and stroke and it is closely associated with fatty liver dementia cancer sleep apnea kidney failure and other diseases This reference work covers the full range of scientific and clinical aspects of obesity and metabolic syndrome epidemiology genetics environmental factors pathophysiology diseases associated with obesity pediatric obesity and clinical management Endocrine Disrupters and Metabolism Yann Gibert,Angel Nadal,Robert Sargis,2020-01-20 *Overweight and the Metabolic Syndrome*: George A. Bray,Louisiana State University,Donna Ryan,2007-02-16 Overweight and the Metabolic Syndrome will provide an overview of topics related to obesity including associated health risks childhood obesity genetics evaluation treatment behavioral strategies and successes and failures in preventing obesity The body composition that underlies obesity and the metabolic syndrome is key to understanding the problem The mechanisms by which energy balance is maintained is key to how the problem goes wrong The metabolic syndrome is in part a consequence of central fat storage but includes more issues such as insulin resistance low levels of inflammation and endothelial dysfunction This volume will cover evaluation guidelines different approaches to treatment including diet exercise behavior drugs and surgery to deal with the current world wide obesity epidemic

**Nutrition and Metabolism** Christos S. Mantzoros,2009-04-20 Nutrition and Metabolism Underlying Mechanisms and Clinical Consequences brings together internationally recognized experts to comprehensively review our current understanding of how nutrition interacts with the genetic substrate as well as environmental exogenous factors including physical activity or the lack thereof to result in insulin resistance and the metabolic syndrome After presenting the scope of the problem the first major part of the book is devoted to genetics and pathophysiology the second part of the book presents the public health perspective of the most prevalent problems associated with nutrition and the metabolic syndrome whereas the third major part of the book focuses on clinical assessment and management of the main disease states associated with inappropriate nutrition and the metabolic syndrome Finally general information useful for both clinicians and researchers alike is presented in the Appendix Nutrition and Metabolism Underlying Mechanisms and Clinical Consequences offers the reader an up to date and authoritative review of the major scientific and clinical aspects of the overlapping areas between nutrition and metabolism *Genetic Endocrinology of the Metabolic Syndrome* Santiago Rodríguez,2009 Cardiovascular disease and mortality risk are significantly increased in people with metabolic syndrome a cluster of interrelated metabolic disorders including obesity insulin resistance glucose intolerance dyslipidemia and hypertension A complex interplay between predisposing and protective factors ultimately determines whether an individual will develop this set of disorders or not Genetic factors are one of the significant contributors that predispose to or protect against each component of the metabolic syndrome As in other complex diseases and traits such genetic factors are likely to be multiple and interacting with individual polymorphisms producing only a moderate effect The identification of genetic variants influencing the metabolic

syndrome is of great importance to understanding pathogenesis identifying groups of individuals with different relative risk and developing or improving therapies against this cluster of metabolic disorders This has greatly stimulated both theoretical and applied genetic research in recent years A range of new analytical tools has been developed for the dissection of complex traits Applied genetic analyses have identified large numbers of candidate markers and chromosomal regions over 600 for obesity which represents only one of the disorders of this cluster In this chapter the authors present a basic overview of the genetic approaches currently used for the identification of candidate genetic factors involved in the metabolic syndrome The authors also summarise current evidence suggesting that genetic variants within elements of the endocrine system are directly involved in the risk of the metabolic syndrome The authors focused their attention on endocrine pathways for which candidate genetic variants have been identified and they introduced the foundations of a new hypothesis which postulates the involvement of a network of endocrine genetic setpoints as a combined contributor to the risk of the metabolic syndrome

**The Ghrelin System** A. Benso, F.F. Casanueva, E. Ghigo, R. Granata, 2013-04-22 The ghrelin story started more than 30 years ago with the discovery of synthetic GH secretagogues Only in 1999 was ghrelin a natural GH releasing peptide discovered Ghrelin however is much more than simply a natural GH secretagogue In fact this hormone is one of the most important factors known for regulating appetite and energy expenditure Furthermore ghrelin is the trigger for other neuroendocrine metabolic and nonendocrine actions This book written by researchers who provided the major contributions to our current knowledge of this complex system gives a comprehensive overview of the recent advances in ghrelin research The hormone's influence on the cardiovascular metabolic and gastroenteropancreatic system hypothalamus pituitary adrenal axis prolactin secretion thyroid axis gonadal axis as well as on behavior is discussed in detail Furthermore the clinical perspectives for ghrelin derived therapeutic products are presented Illustrating the tight inter relationship between endocrinology metabolism cardiovascular disease and internal medicine this book is essential reading for all scientists interested in appetite control body weight and energy expenditure as well as diabetes mellitus and neuroendocrinology

*Metabolic Effects of Psychotropic Drugs* J. Thakore, B. E. Leonard, Brian E. Leonard, 2009-07 Major depression and bipolar disorder are chronic enduring serious mental illnesses SMI with devastating effects on psychosocial functioning and may culminate in suicide Over the past years it has become apparent that subjects with these conditions can also develop the metabolic syndrome which is a series of obesity related physical conditions with an endocrine basis This book brings together reviews that help put into context exactly why subjects with SMI develop obesity prediabetic status overt type 2 diabetes mellitus and related cardiovascular events The relationship between prolactin and bone mineral density in subjects under medical treatment and the underlying dopaminergic mechanisms as well as the immunological changes occurring as an integral part of SMI and their effects on endocrine function are discussed and reviewed Psychiatrists diabetologists cardiologists family practitioners public health physicians as well as basic science researchers will find valuable guidelines

when screening for type 2 diabetes mellitus and cardiovascular disease in SMI      **Endocrine Surgery - Best Practice and Research Clinical Endocrinology and Metabolism - vol 15 n 2 June 2001** John R. Farndon, 2001      **The Metabolic Syndrome:** Barbara C. Hansen, George A. Bray, 2010-11-09 This book covers the most important clinical and bench science aspects of metabolic syndrome. It will be of value to all of those seeking a comprehensive update on the metabolic syndrome. Furthermore, it will provide a broad basis for advancing research in the multiple intersecting disciplines encompassed by the metabolic syndrome.      *Inborn Metabolic Diseases* Jean-Marie Saudubray, Matthias R. Baumgartner, John H. Walter, 2016-10-28 This work is recognised as the standard textbook for professionals involved in the diagnosis and management of inborn errors of metabolism (IEM) and an essential resource in this multidisciplinary field. For the 6th edition, all 43 chapters have been newly written or revised by authors with particular expertise in their subject areas. Contents: A clinical and biochemical approach to the recognition and diagnosis of IEM with algorithms to symptoms, signs and syndromes in patients of all ages; Emergency treatments; Medications; Separate comprehensive sections on IEM of Carbohydrates; Mitochondrial Energy; Amino and organic acids; Vitamin responsive defects; Neurotransmitter and Small peptides; Lipid and Bile Acids; Nucleic Acid and Heme; Organelles; Disorders affecting the synthesis and remodelling of complex lipids and fatty acid homeostasis are now included.      *Clinics in Endocrinology and Metabolism*, 1983      Metabolic, Nutritional and Endocrine Disorders World Health Organization, 1991

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