

Baro-Cybernetics

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Abstract

Cybernetics is a transdisciplinary science which studies circular causal processes such as feedback and recursion. Its concepts are concordant with those of modern endocrinology. In this opinion piece, we focus on baro-cybernetics, viewing cybernetics through an obesity perspective. Baro-cybernetics may be defined as the transdisciplinary study of feedback mechanisms which help in weight homoeostasis, during health and disease. Baro-cybernetics includes not only basic sciences such as biochemistry and physiology, but the application of these concepts to psychology and pharmacology of obesity.

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Introduction

Cybernetics is a transdisciplinary science which studies circular causal processes such as feedback and recursion, where a system's actions (or outputs) work as stimuli (or inputs) for its subsequent actions. Heard commonly in engineering, ecology and economy, cybernetics is not a frequently used term in health and medicine. The book Psycho-Cybernetics, by Maxwell Maltz, was a landmark in correlating human psychology with the science of cybernetics.¹

The application of cybernetics is not limited to computer science or artificial intelligence. The Macy Cybernetic Conferences defined cybernetics as the study of circular causal and feedback mechanism in biological and social systems.² This sets the stage for us to propose endocrine cybernetics as the science of hormonal feedback mechanisms.

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Definition

In this opinion piece, however, we focus on baro-cybernetics, viewing cybernetics through an obesity perspective. Baro-cybernetics may be defined as the transdisciplinary study of feedback mechanisms which help in weight homoeostasis, during health and disease. Baro-cybernetics includes not only basic science such as biochemistry and physiology, but the application of these concepts to psychology and pharmacology of obesity.

Biocybernetics

Bio-cybernetics, in fact, is a useful term which can serve as a synonym for endocrinology. It is especially apt as it encompasses and encapsulates the twin regulatory edifices of the endocrine and autonomic nervous system. For the purpose of this communication, however, we prefer to use baro-cybernetics, so as to focus on the syndrome of obesity.

Positive Feedback

As students of endocrinology are well aware, the complexity of feedback patterns is still being unearthed. Though conventional science is built upon the Newtonian concept of negative feedback mechanism, positive feedback cycles do occur in homoeostasis. These include the kisspeptin-included luteinizing hormone (LH) surge of ovulation, cortisol-stimulated rise in placental corticotropin-releasing hormone (CRH) during pregnancy, oxytocin-induced uterine contractions, and prolactin and lactation. Readers and researchers also appreciate the quantum nature of metabolic homeostasis,³ with multifaceted cobwebs of causation, contribution, complication and corrective strategies.

Barocrine Circuitry

Neuroendocrine circuitry or more aptly, barocrine circuitry is a complex connection of homoeostatic, habitual and hedonistic hunger, nutrient absorption and assimilation, as well as energy expenditure. These physiological phenomena are linked by neuro endocrine signals and cues, to ensure weight homoeostasis. In states of health, baro-cybernetic mechanisms ensure maintenance of weight around a metabolic setpoint.⁴

Disorders of Eating

In states of ill-health, the same barocybernetic bliss turns into a maladaptive barocybernetic burden, perpetuating an unhealthy weight. This situations in noted in both

obesity and undernutrition. Eating disorders such as anorexia nervosa and bulimia nervosa are characterized by abnormal eating behaviour, which leads to psychological and endocrine morbidity that perpetuates the unwanted habit.⁵ Modern diseases like orthorexia nervosa,⁶ exertitium nervosa and orthosomnia, characterized by a preoccupation with monitoring one's behaviour, lead to an ever-deepening dependency on devices, gadgets and gizmos.

Modification in Malnutrition

Children with protein energy malnutrition PEM undergo stunting and muscle wasting, which reduces their energy requirement, and in turns suppresses their appetite. In fact, the refeeding syndrome⁷ described in survivors of chronic malnutrition is an example of how deeply baro-cybernetic principles are able to establish themselves in nutritionally-deprived states.

An extreme example of such baro-cybernetics is reported in *Homo floresiensis*, an ancient species of *Homo* genus. This species, which lived on the Indonesian island of Flores 50000 years ago, was about 3 feet in height. This was thought to be an evolutionary adaptation, to survive in the face of limited nutritional resources, on an isolated landmass with no natural predators.⁸

Alterations in Obesity

It is in obesity, however, that we see a pathophysiological platform, as well as psycho-therapeutic potential of biocybernetics. Initiation of hedonistic hunger whether due to endogenous causes (orexigenic hormones and neuro transmitters) or exogenous factors (environmental exigencies and social stimuli) lead to integration and intensification of such patterns. The resultant weight gain creates physical as well as psychological comorbidities and complications, which interfere in effective exercise. This creates a vicious cycle of energy imbalance, which perpetuates obesity.⁹

Clinical Applications

While we understand that this binary baro-cybernetic framework is outdated, it sets the stage for enhanced understanding of the syndrome. The barocybernetic framework acknowledges the presence of positive feedback mechanisms which serve to protect and perpetuate hedonistic and habitual hunger. It is equally applicable to syndromes of malnutrition, such as eating disorders and protein-energy malnutrition (PEM).

Baro-cybernetics is relevant not only for the study of esoteric or outdated nutritional diseases, but also for the management of obesity. Monogenic forms of obesity, such as leptin deficiency and can be better understood as

defects in bio cybernetic regulation, and treated as such.

Exogenous obesity, which has emerged as a major pandemic, concurs with the principles of biological cybernetics. The management of obesity is based upon behavioural therapy. This involves an understanding of one's thoughts, words and actions, or attitudes, behaviours and choices (ABC), followed by addressal and optimization of unhealthy traits. Behavioural therapy is offered in conjunction with advice regarding nutrition and exercise, thus facilitating a modest calorie deficit. Medications must be used where indicated, to help suppress appetite, improve metabolic parameters, reduce weight, and enhance long-term cardio vasculo metabolic outcomes.¹⁰

Esemplastic Explanation

It is sometimes challenging to explain the complex cobweb of causation and complication that obesity is. Models such as the octagon of opportunities, and 4BE winged quincunx offer clarity and comprehension.⁹⁻¹¹ Baro-cybernetics takes this endeavour forwards, proposing a self-propagating vicious cycle of positive feedback, that ultimately harms the person living with obesity. It also suggests how modern medication and adjuvant therapy can intervene in this process, and convert it into a virtuous cycle of weight maintenance.

Modern antiobesity drugs may be likened to the proverbial ugly duckling, in search of an identify. Advances in peptide pharmacology have allowed development of permutations and combinations of these molecules, leading to a search for new nomenclature. While nutrient stimulated xx is one proposal for the prodigal peptides, baro-cybernetic balancers may be a more apt label for liraglutide, semaglutide, tirzepatide, and the various coformulation being studied.

Pedagogic Application

Margaret Mead has defined cybernetics as a cross-disciplinary thought which facilitates inter-disciplinary communication.¹² This allows us to include endocrine education and training within the rubric of cybernetics.

The concept appeals to endocrinologists, who understand feedback mechanisms; psychologists, who appreciate neurocognitive programming; and the modern generation, who use the prefix 'cyber' in a multitude of manners. It aligns with our understanding of not only obesity, but other nutritional disorders as well. While being cognizant of the various hormones and neurotransmitters that we are aware of, the inclusive nature of barocybernetics keeps the door ajar for newer chemicals and receptors that may be discovered in the future.

The term also encourages, to our mind, an inclusive

multidisciplinary approach towards obesity management. Though primarily an endocrine disease, obesity needs attention from multiple professions and disciplines. Social/community medicine neuro psychology and artificial intelligence machine learning are some specialties that must join the fight to prevent and manage obesity.

Summary

Barocybernetic bliss and blessings for all, is what we aim to achieve. Through this communication, we call for a holistic understanding of obesity, its endocrine and meta endocrine connections and ramifications, and its management.

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