APPLICATION OF DIFFERENTIAL EQUATIONS TO THE STUDY OF THE THYROID SYSTEM

MONES BERMAN
NATIONAL INSTITUTES OF HEALTH

1. Introduction

This paper deals with the application of newly developed techniques of data analysis to studies presently in progress on the thyroid system using isotope tracers. In general, the biological system that one encounters in an in vivo tracer experiment is quite complex. The tracer experiment alone is inadequate to define it, and one tries to construct a substitute system from the data that will approximate the behavior of the actual system. This substitute system serves as a model for the true system and its complexity or resolution is no greater than the experimental data justify. A degree of arbitrariness is present in deciding how complex a model should be, and this depends on statistical, physiological, and biochemical considerations.

When a model compatible with all the available information on the system is derived, one tries to correlate the parameters of the model with known physiological and biochemical entities. One also tries to correlate changes in the values of the model parameters with known clinical or physiological abnormalities. Successes or failures of these attempts serve as additional criteria in the development of an acceptable model.

The reasons for choosing to discuss the thyroid system are: first, the thyroid system is sufficiently complex to represent many of the problems one encounters in the analysis of tracer experiments in general; second, we have a number of studies on this system that are presently being analyzed. In collaboration with Drs. D. Becker of the New York Hospital, and M. Sonenberg and R. S. Benua of the Sloan Kettering Institute, New York, kinetic studies were performed on a number of patients with various thyroid abnormalities. Ezra Shahn of the Institute for Arthritis and Metabolic Diseases has participated in the development of some of the techniques described and programmed the computational procedures for an IBM 704 computer.

2. The "thyroid system"

The term "thyroid system" is defined to include the major phases involved in the production, utilization, and regulation of thyroid hormone. The hormone is