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*Chronobiology International*, Vol. 7, No. 3, pp. 239-243, 1990  
Printed in Great Britain.

0742-0528/90 \$3.00 + 0.00  
Pergamon Press plc  
International Society of Chronobiology

## COMPUTERIZED CHRONOTHERMODYNAMIC BREAST EXAMINATIONS UNDER AMBULATORY CONDITIONS

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(Presented at the Fourth International Conference of Chronopharmacology and Chronotherapeutics, March 1990)

**Abstract**—A new approach to the assessment of breast health was developed based upon continuous ambulatory recording of breast temperature for 24 hrs. A new data acquisition system consisting of a portable, multi-channel, microprocessor-based recorder worn on a belt was developed to record temperatures. Dramatic thermal fluctuations were noted during the recordings in response to multiple stimuli (physiological, behavioral, environmental). Specific algorithms and software programs were developed to process the thermobiologic and chronobiologic information. Data processing was fully automatic and included an examination report indicating a score and a chronothermodynamic class for each of the five areas examined on each breast. The preliminary clinical studies have concerned more than 450 patients with healthy or diseased breasts.

**Key words**—Ambulatory monitoring, breast temperature, thermobiology, chronobiology, breast diagnosis, breast cancers.

### Introduction

Wunderlich's 1870 treatise "On the Temperature in Diseases" (1) laid the foundation for the introduction of thermometry into clinical medicine. Since that time, longitudinal studies of temperature rhythms in humans have been hampered by the need to place subjects in a controlled environment where individual temperature measurements could be recorded accurately. Recent progress in the miniaturization of data recording and storage devices has allowed us to develop a totally new approach to ambulatory recording of human temperatures. This approach can have important implications for the early detection of such diseases as breast cancers.

Our interest in skin temperature variations and breast cancer dates back to 1977, when the senior author showed that breast cancer produced significant alterations in the circadian thermal rhythms of skin overlying the tumor (2). These findings confirmed previous studies by Mansfield *et al.* (3) and Smolensky *et al.* (4).

Unfortunately, these early investigations have had little practical application, because the protocols all called for strict control over the thermal environment surrounding the test subjects in addition to regulation of sleeping and eating schedules, and thermal insulation of the breast.

Based upon the hypothesis that a more accurate picture of the thermochronobiological status of the breast could be obtained if efforts were made to assess breast temperature in the presence of the internal and external stimuli which generally affect a woman, we began in 1979 to develop portable, light-weight, multi-channel recorders with high internal data storage capability for longitudinal recording of breast temperatures on an ambulatory basis. After conducting appropriate feasibility studies and devising numerous prototypes, we developed miniaturized temperature monitoring devices based on state-of-the art microprocessor and microelectronic technology, and software programs for the objective, quantified analysis of the

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