PRINCIPLES OF OBSTETRICS

Edited by

Ronald M. Caplan, M.D.

Principles of Obstetrics

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WILLIAMS & WILKINS
Baltimore/London

Made in the United States of America

Library of Congress Cataloging in Publication Data

Main entry under title:

Principles of obstetrics.

Includes index.
1. Obstetrics. I. Caplan, Ronald M. [DNLM: 1. Obstetrics. WQ 100 P9572]
RG524.P825   618.2   81-14794
ISBN 0-683-01436-6   AACR2

Composed and printed at the
Waverly Press, Inc.
Mt. Royal and Guilford Aves.
Baltimore, MD 21202, U.S.A.

Principles
of
Obstetrics

To William J. Sweeney III, M.D.

superb clinician, confidant, friend.

PREFACE

We no longer can expect a medical student to be totally competent in the practice of obstetrics for several reasons. Among these are lack of sufficient curriculum time and lack of sufficient numbers of pregnant patients "available" at many schools of medicine for the medical student to deliver. The rapid expansion of knowledge in the field and the goal of giving each mother an infant in optimal condition make it mandatory for the person caring for the pregnant patient to be knowledgeable and experienced and to have access to immediately available expert help and sophisticated equipment in case of complications.

In this setting, we assume that anyone desirous of caring for the pregnant patient and her forming child will avail themselves of appropriate postgraduate training.

It is essential, however, for every medical student to have a thorough grounding in reproductive physiology as part of the greater understanding of the functioning of the human body. The student should be aware of the new physiologic demands of pregnancy and of how these may alter various disease states. The diagnosis of pregnancy should be learned: this should be kept in mind when dealing with any female patient in her reproductive years. It is important to understand the mechanisms of labor and delivery as part of the physiologic interaction between mother and child.

It is with this philosophy in mind that this textbook was written.

ACKNOWLEDGMENTS

I wish to acknowledge the contribution of Dr. Graham Hawks, who has been instrumental in providing statistical and clinical data. I appreciate the enthusiasm of Dr. William Ledger, who has been most supportive. Most importantly, I wish to thank the contributors, whose unselfish hard work and expertise were instrumental in the creation of this text.

Ms. Diane Abeloff and Mr. Michael Budowick are superb professionals: they are the creators of the original drawings in the book.

I thank Ms. Charlene Varnis for her help with the statistics and Ms. Randy Sue Caplan for many hours of library research. My gratitude is extended to Dr. Joseph F. Artusio, Jr., and Dr. Fritz Fuchs for their constructive suggestions.

I wish to convey my sincere gratitude to Ms. Susan Vitale of the Williams & Wilkins Company for her innovative thought, support and understanding, without which this text would not have been written. I also thank the many others in the Williams & Wilkins organization who have done so much to bring this book to fruition.

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CONTENTS

Section 1
Reproductive Physiology

CHAPTER 1

The Menstrual Cycle

BRIJ B. SAXENA, Ph.D., D.Sc.

The measurement and the study of the interaction of the hormones secreted by the central nervous system (CNS)-hypothalamic-hypophyseal-gonadal axis have provided insight into the sequence of events in the regulation of the menstrual cycle. This has been done by the application of sensitive, specific radioimmunoassays in the determination, in the same individuals, of daily or more frequent levels of endocrine and neuroendocrine components which circulate in low concentrations in the body fluids.

In the human, the menstrual cycle is the result of a precise coordination of the functional characteristics of the central nervous system, the hypothalamus, the pituitary, the ovary and the endometrium, which regulate the cyclic release of the gonadotropin releasing factors (luteinizing hormone-releasing hormone: LH-RH), gonadotropins (follicle stimulating hormone: FSH, and luteinizing hormone: LH) and ovarian steroids (estradiol: E_2, and progesterone). Prolactin and prostaglandins play a facilitatory role in the regulation of the menstrual cycle. In general, ovulation does not occur prior to menarche. The menstrual cycle is timed from the onset of blood flow to the similar onset with the next cycle. During the normal reproductive years this period is of an average of 28 days. However, an increase in the intermenstrual interval occurs at adolescence and at the menopausal transition due to the frequent occurrence of anovulatory cycles. Due to variability in the length of the menstrual cycle from 28 to 35 days, the day of maximum preovulatory LH surge has been used as a marker for the midcycle or the "O" day (Fig. 1.1). The period from the day of menses until 1 day prior to the LH surge is designated as the *follicular* or *preovulatory* phase, which can be functionally subdivided into the first half as "early" and the late second half as "late" follicular phases, each of 7 days' duration. The late follicular phase is followed by an "ovulatory" phase. During this period, there is a rapid rise in the plasma LH level which leads to ovulation, which is the final maturation of the Graafian follicle in the ovary; the follicle ruptures approximately 24 hours following the LH surge, resulting in the formation of the corpus luteum. The interval between the beginning of the maturation of a follicle and ovulation is as yet unknown. The period between 1 day following the LH peak and the day of the onset of the next menses is designated as the *luteal* or *postovulatory* phase. The first half of the luteal phase can be considered as the "early luteal phase" and the second half as the "late luteal phase."

MORPHOLOGICAL CHANGES

From the seventh month of fetal life until the menopause, follicular maturation is continuous in the ovary. After the menarche, atresia, a follicular degenerative process which continues until the last oocyte is removed from the ovary, persists.[12, 21] Ovulation of one follicle gives rise to a corpus luteum during each menstrual cycle. Ovulation begins with rapid enlargement of a follicle and is followed by its protrusion from the surface of the

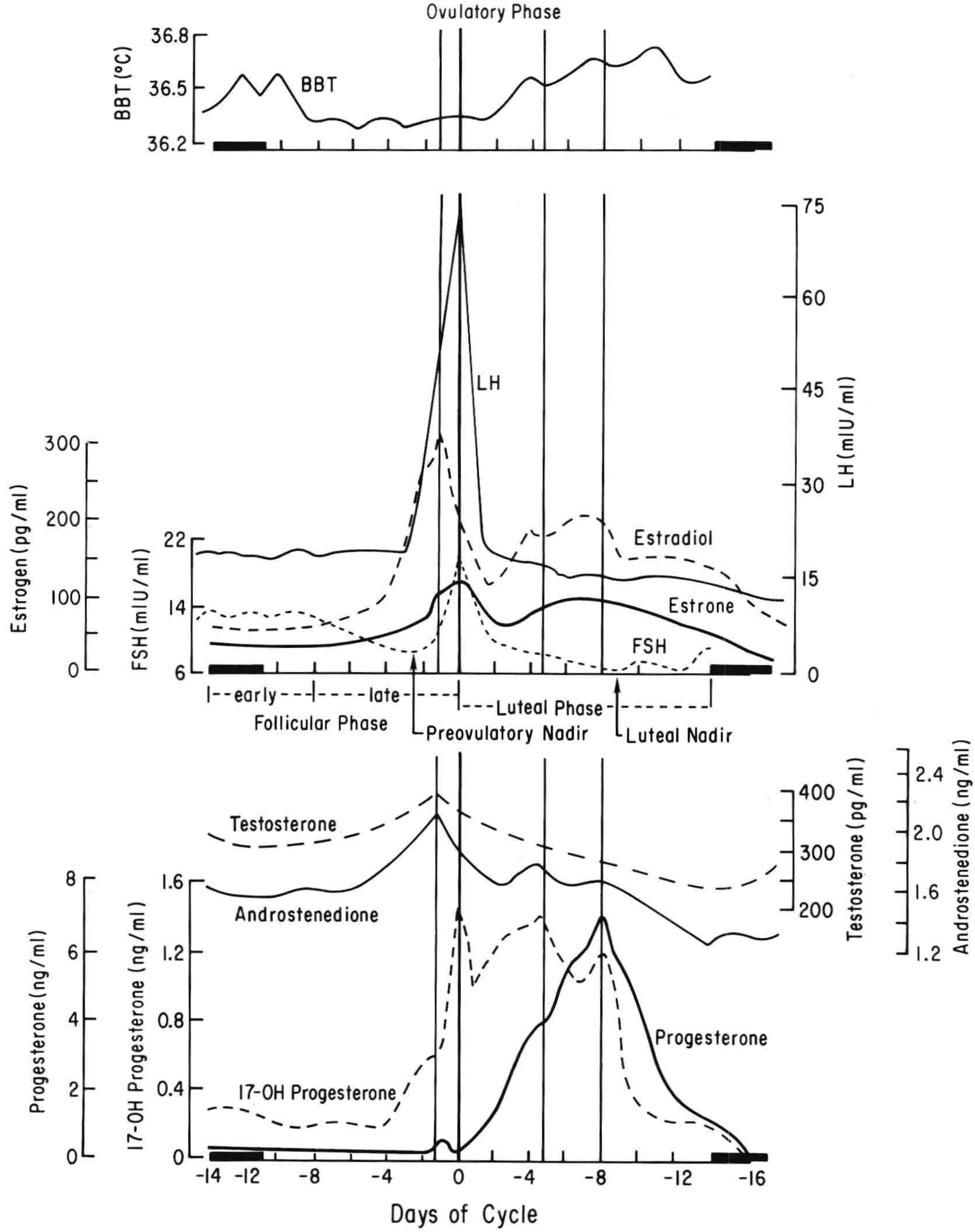

Figure 1.1. Hormonal levels in the menstrual cycle. The basal body temperature curve shown in the top figure is biphasic, rising after ovulation. The dramatic preovulatory LH surge is shown.

ovarian cortex and rupture, with an extrusion of an oocyte and adhering cumulus oophorus.[4] In the human ovary, this sequence occurs over a 5–6 day period prior to the preovulatory LH surge which precedes actual rupture by as much as 16 hours.[30] Following rupture of the follicle, capillaries and fibroblasts from the theca cells proliferate and penetrate the basal lamina. The mural granulosa cells undergo "luteinization," and these cells, surrounding theca cells, capillaries and blood vessels intermingle to give rise to the corpus luteum.[10] The corpus luteum is the major source of steroid hormones secreted by the ovary during the postovulatory phase of the cycle.[15] Endometrial development is necessary for implantation: in unfertilized cycles, regression of the endometrium occurs in the form of menstrual bleeding. The corpus luteum functions for about 14 ± 2 days, after which it spontaneously regresses and is replaced by an avascular scar called a *corpus albicans*, unless pregnancy occurs.[28] The endometrial changes and their correlation with the menstrual cycle are presented in Figure 1.2. In an ideal 28-day cycle in a normal woman, after ovulation the progestational or secretory phase lasts 14 days and is followed by 3 days of menstruation which is succeeded by 11 days of the proliferative phase during which the repair of the endometrium takes place. Prior to the onset of menses, there is withdrawal of estrogen and progesterone and desquamation of the endometrium. Bleeding is preceded by intense spasmodic constrictions (vasospasm) of the spiral arteries of the uterus and ischemic necrosis. Vasospasm and increased uterine contraction are thought to be initiated by local production of prostaglandins, which are found in high concentrations in the menstrual blood.[29] The estrogen and progesterone withdrawal causes a decrease in lysosomal stability and a release of phospholipase which stimulates prostaglandin synthesis. Aspirin and indomethacin increase the stability of lysosomal membranes and inhibit the prostaglandin synthesis. The menstrual flow is also facilitated by the noncoagulability of the blood due to the fibrinolytic activity of the endometrium, which is maximum at the time of menstruation.

GONADOTROPIN-OVARIAN INTERACTIONS IN THE REGULATION OF THE MENSTRUAL CYCLE

The human fetal pituitary produces FSH and prolactin preferentially, even prior to the establishment of the hypothalamic-hy-

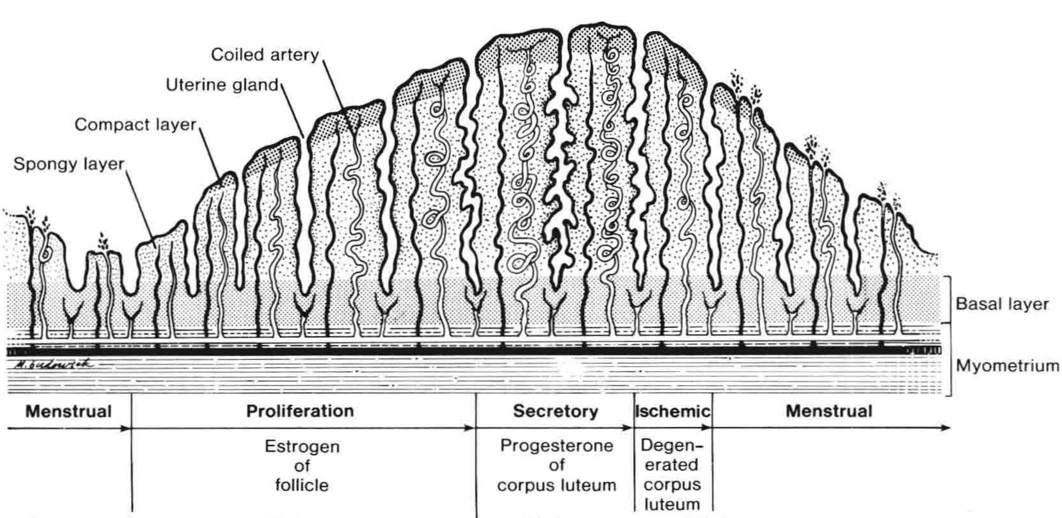

Figure 1.2. Endometrial changes and their correlation with the menstrual cycle.