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Obstetrics in Family Medicine

A Practical Guide

Third Edition

Humana Press

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Preface

One of the joys of working in obstetrics is the privilege of being present as the current generation gives rise to the next generation. It is, of course, not the transition in its entirety, but it is a seminal moment in the journey. Over the years, I have been blessed to be present with thousands of women and their families at precisely that moment, to share in that journey and all its associated emotions—hope, fear, anxiety, disappointment (on occasion), and joy.

When I wrote the first edition of this textbook, I was in the midst of that journey in my own life with a young career and an even younger family. With this third edition, my children are now grown, my professional life has evolved, and I am pleased to both recognize and acknowledge those changes. I am grateful to my wife, Cynthia, who continues to provide support and inspiration, and to my two children, Devin and Dylan, now delightful young adults, who give me great hope for and faith in the next generation.

With this edition I am pleased to share in generational change, in the professional sense as well. As my professional life has less direct involvement in delivery of obstetrical patient care, I have become in some ways the audience for as much as the author of this text, "all of us who care for women may find it useful to have a reference that addresses key clinical issues in this important element of women's health," as I noted in the preface to the second edition. In that transition, I have been blessed to be present with young professionals who represent the future such care. I am pleased to share the creation of this edition with Dr. Nathan McLaughlin, a delightful young physician who gives me great hope for and faith in what comes next.

San Bernardino, CA, USA Paul Lyons

Preface

Having great mentorship is instrumental to success and can greatly affect one's trajectory in life. I am lucky to have had a sizeable number of influential mentors that have shaped my education and career. In medical school, it was Dr. Michelle Whitehurst-Cook and Dr. Steve Crossman providing shining examples of what family physicians could be. During residency training Dr. Evelyn Figueroa and Dr. Mark Potter were there to guide me into full-spectrum family medicine including obstetrics, which has enriched my life greatly. I am indebted to those listed above and countless others who have helped to bring me to where I am today.

Over the past 6 years, Dr. Paul Lyons has provided me with mentorship, support, guidance, and opportunity that I could only dream of. The most recent opportunity was in the form of this book. Being asked to help write this third edition of *Obstetrics in Family Medicine: A Practical Guide* is a great honor, and honestly one that I never expected. Dr. Lyons' casual belief in me bolstered my confidence to take on a task that was beyond anything I had done before. Despite his constant assertions that he really doesn't do anything, his impact on me has been immense. I can only hope to provide others with the guidance and support that my mentors have given to me, for without that support I truly would not be where I am today.

Most importantly, I would like to thank my loving wife, Whitney Sullivan-Lewis, MD, for providing me with endless support and reassurance that allow me to have a fulfilling life and career. She is an amazing doctor, wife, and mother, and I should tell her this more often than I do. Lastly, all of my love and affection to my two daughters, Virginia and Josephine, who love me, despite my imperfections, and serve as a constant reminder of what is truly important in life.

Riverside, CA, USA — Nathan McLaughlin

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Key Points

1. The menstrual cycle can be considered a comprehensive physiological adaptation for potential pregnancy.
2. Normal menstrual cycles last 21–45 days (average 28 days), counted from the first day of menstrual bleeding.
3. Physiological adaptations of pregnancy affect most major organ systems including cardiac, renal, gastrointestinal, and endocrine systems.

Background

Although most patients will not present to their providers with questions concerning the specifics of reproductive physiology, the care and management of pregnant patients begin with an understanding of the physiological environment in which pregnancy occurs (or in some instances, does not occur). Many women's health providers will face questions concerning menstrual function prior to caring for a

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patient's obstetrical needs. Conversely, routine gynecological care may provide an opportunity to begin discussions of pregnancy planning and preconception counseling. For many women, a "routine" gynecological examination is the primary point of contact with the health-care system early in life. For this reason, all providers who care for women should have some understanding of normal reproductive physiological function. A brief overview of menstruation, fertility, and pregnancy follows.

Physiology of Menstruation

Menstruation represents the cyclical physiological preparation for potential pregnancy, followed by removal of endometrial contents if pregnancy does not occur. Most women of reproductive age are familiar with menstruation. The average age of menarche in the United States is approximately 11.5 years. Most menstrual cycles are anovulatory in the first year following menarche and may remain irregularly ovulatory for up to 3 years (although women and providers should be aware that ovulation and/or pregnancy may occur). For the next three to four decades, most women will menstruate every 21–35 days (average 28 ± 7 days). Bleeding is variable but generally lasts 3–5 days (1–7 days may be considered normal) and is of variable intensity (but generally less than 3 oz or 90 cm^3).

Although generally considered an ovarian and uterine phenomenon, the normal menstrual cycle may be considered as a comprehensive physiological adaptation in preparation for possible pregnancy. In addition to the uterine and ovarian changes described here, changes can be noted in the cervix, vagina, breast, and core body temperature. The cervical mucus becomes thinner with increased pH to facilitate entry of sperm. Vaginal epithelial cells also undergo change. Mammary ducts proliferate under estrogen and progesterone stimulation, which may lead to breast swelling and tenderness. A small spike in basal body temperature can be seen at the time of ovulation. This observation has contributed to the use of basal body monitoring in fertility management.

Physiologically, bleeding represents the end of one cycle. From the perspective of the patient and the provider, however, bleeding is the most easily identified aspect of the menstrual cycle and is, therefore, used to mark the beginning of each cycle. The first day of menstrual bleeding is day 1 with each day numbered sequentially through the last day prior to the recurrence of bleeding. Each menstrual cycle can be divided into two-halves that differ in hormonal and physiological events. In a typical or average menstrual cycle, each half is approximately 14 days in duration.

The first half of each menstrual cycle is marked by endometrial proliferation and follicular development. In the first week of each menstrual cycle, multiple follicles enlarge. At approximately 1 week, a single follicle becomes dominant and the others involute, becoming atretic. The dominant follicle will, with appropriate hormonal regulation, continue to develop and will eventually rupture releasing an ovum for possible fertilization. With release of the ovum on day 14, the follicle undergoes a series of stereotypic changes filling with blood, granulose, and thecal cell prolif-

eration and displacement of blood by luteal cells (corpus luteum). The luteal cells produce progesterone, which serves to stabilize the thickened endometrium through the second half of the menstrual cycle. The period of follicle development is referred to as the follicular phase. The period of luteal production of progesterone is referred to as the luteal phase.

Follicular development in the first half of each menstrual cycle is marked by follicular production of estrogen and endometrial proliferation in anticipation of possible implantation of a fertilized ovum. This generally occurs late in the first week and throughout the second week of the menstrual cycle. The first half of the menstrual cycle is, for this reason, sometimes referred to as the proliferative phase. With ovulation and luteal production of estrogen and progesterone, uterine glands become active, secreting clear fluid. This phase is referred to as the secretory phase. The endometrium will remain stable and secretory for as long as the progesterone stimulation continues.

If fertilization fails to occur, the corpus luteum will lose function beginning in the second half of the fourth week (corpus albicans). With the loss of hormonal support, endometrial thinning and localized necrosis lead to sloughing of the proliferative portion of the endometrial lining and the onset of menses. Until menopause, this cycle will repeat more or less regularly each month.

Physiology of Fertility

The hormonal changes just described relate to preparation for release of the ovum and subsequent fertilization by sperm. As noted, however, these menstrual changes may occur in the absence of ovulation. In addition, under normal physiological conditions, pregnancy requires the presence of functional sperm in sufficient quantity to ensure fertilization of the released ovum.

In women, the release of an ovum is under the control of the hypothalamic–pituitary–ovarian endocrinological axis. Each of these components must function normally to ensure ovum release. Two pituitary hormones, in particular, are critical to normal ovulatory cycles—follicle-stimulating hormone (FSH) and luteinizing hormone (LH).

Hypothalamic Function

Release of pituitary hormones depends on hypothalamic stimulation. The hypothalamus is responsible for stimulation of a variety of pituitary hormones, and hypothalamic dysfunction may manifest with altered fertility or a variety of other endocrinological signs or symptoms. In addition to pituitary stimulation, the hypothalamus is responsible for direct release of oxytocin (of import at the time of labor).

In relation to fertility, hypothalamic release of gonadotropin-releasing hormone (GnRH) stimulates the anterior pituitary production of FSH and LH. GnRH is produced in the hypothalamus and released directly to the pituitary via local blood vessels. Release of GnRH is episodic in brief, timed bursts. Although GnRH cannot be measured directly, pulsatile GnRH release results in pulsatile release of LH which can be measured providing indirect evidence of hypothalamic function. Failure to maintain this episodic release will inhibit pituitary stimulation, probably secondary to downregulation of pituitary receptors. Disruption of the timing of the episodic release will also impair fertility by disrupting the appropriate timing of FSH and LH stimulation of the ovary. In addition, appropriately episodic and timed GnRH stimulates pituitary GnRh receptors enhancing sensitivity at mid-cycle and facilitating a surge in LH at the time of ovulation.

Pituitary Function

As with the hypothalamus, the pituitary is responsible for the release of several hormones regulating a variety of physiological functions. In relation to fertility, the two key hormones are the gonadotropins, FSH and LH. These two agents are released cyclically and in a pulsatile fashion in response to GnRH stimulation. Together they are responsible for regulation of ovarian hormonal secretion. Pituitary release of FSH and LH is also regulated by ovarian hormone release. Ovarian release of estradiol results in negative feedback (inhibition) of FSH release and positive feedback (stimulation) of LH release.

FSH, as the name implies, is responsible for stimulating early follicle development within the ovary. LH fosters ovarian production of estrogen and progesterone from the corpus luteum. In conjunction with LH, FSH is also responsible for terminal maturation. At the point of maturation, a surge in LH levels precipitates follicular rupture and ovum release.

Ovulation

Early in the menstrual cycle, FSH levels are slightly elevated (stimulating follicular development), and LH levels are low. In this phase of the menstrual cycle, estrogen serves an inhibitory role on LH. GnRH stimulation of the pituitary continues, and the sensitivity of the pituitary is enhanced. Approximately 2 days prior to ovulation, the estrogen inhibition is reversed, becoming stimulatory, and a positive feedback loop is established. Approximately 8–10 h prior to ovulation, LH levels reach a peak

(LH surge). Ovulation then occurs. Following ovulation, estrogen once again becomes inhibitory and, in conjunction with elevated progesterone levels, serves to inhibit LH and FSH levels in the second half of the menstrual cycle.

Physiology of Pregnancy

The physiological changes associated with pregnancy are numerous, and the full scope of such changes is beyond the scope of this text. Common physiological changes with pregnancy are summarized in Table 1.1. Recognition of normal physiological changes

Table 1.1 Physiological changes of pregnancy

Cardiovascular
Cardiac enlargement
Increased cardiac output
Systolic flow murmur
Decreased venous return
Decreased peripheral vascular resistance
Decreased blood pressure
Increased blood flow to the uterus, kidneys, skin, breasts
Renal/urinary
Increased urinary stasis
Increased urinary system volume
Kidney enlargement
Renal pelvis dilatation
Ureteral elongation
Increased bladder capacity
Increased glomerular filtration rate
Elevation of renin, aldosterone, angiotensin
Glucosuria
Gastrointestinal
Early satiety
Nausea, vomiting
Constipation
Gingival hypertrophy
Progression of periodontal disease
Decreased gastric emptying
Relaxation of lower esophageal sphincter
Hematological
Increased red blood cell volume
Anemia
Leukocytosis

is necessary not only to understand normal function while pregnant but also to facilitate recognition of physiological abnormalities that lie outside the normal range.

Cardiovascular Changes

Pregnancy can be considered an adaptive high-volume, hyperdynamic cardiovascular state. Increased volume, a newly developed peripheral vascular bed, and anatomic changes associated with an enlarging uterus all serve to alter normal cardiovascular status. The heart, itself, enlarges, and cardiac output increases by nearly 50%. This increased output is initially facilitated by an increase in cardiac volume and subsequently by an increase in heart rate. The increase in output reaches a peak near the end of the second trimester and then remains stable until the end of pregnancy.

The increase in volume may lead to increased flow turbulence within the heart. This turbulence may be apparent clinically as a systolic ejection murmur. Such a murmur will manifest in 80–90% of all pregnant women. This murmur is a normal physiological finding and does not warrant further cardiovascular investigation.

Vascular changes are also common in pregnancy. With an increase in uterine size, venous return via the inferior vena cava may be directly impaired. Placing the patient in the left lateral recumbent position may alleviate the direct pressure of the uterus on the vena cava and facilitate enhanced venous return. The direct compression of venous return from the lower extremities may lead to peripheral edema. Peripheral vascular resistance declines with pregnancy as maternal cardiac output increases. Compensatory venous response to rapid position changes may also be impaired in pregnancy causing light-headedness or dizziness with rapid positional changes. Blood pressure often declines slightly (approximately 10 mmHg diastolic) with a nadir in the second trimester and a slight rise (to near prepregnant levels) near the end of pregnancy.

Blood flow is altered in pregnancy as well. The most obvious change is the increase in uterine blood flow with the development of the uteroplacental vascular bed. Blood flow through this vascular bed is facilitated by vascular resistance that is low relative to the overall peripheral vascular resistance. In addition to increased blood flow to the uterus, maternal blood flow is increased to the kidneys, breast, and extremities (including increased flow to the skin). Although concern has been raised that exercise may divert blood flow from these key areas to muscles, this has generally not been found to be clinically significant except for women who significantly increase their activity level from their prepregnancy baseline. A reasonable recommendation would be that women may continue exercise through pregnancy at a level not to exceed their usual degree of exertion.

Renal/Urinary Changes

Pregnancy is marked by an increase in urinary stasis. The direct impingement of the uterus and fetus on the bladder contributes to this effect as do anatomic changes within the urinary tract. Kidneys enlarge, the renal pelvis dilates, and the course of