Puerperium
Normal and abnormal postpartum period

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The puerperium is strictly defined as the period of confinement during and just after birth. By popular use, however, the meaning usually includes the six subsequent weeks.

- Wound recovery
- Hormonal changes
- Involution of the organs
- Evolution of the breast
UTERINE CHANGES

Uterine Vessels
Cervix and Lower Uterine Segment
Involution of the Uterine Corpus
Endometrial Regeneration
Placental Site Involution
Uterine Vessels

After delivery, the caliber of extrauterine vessels decreases to that of the prepregnant state. Within the puerperal uterus, larger blood vessels are obliterated by hyalin changes, gradually resorbed and replaced by smaller ones. Minor vestiges of the larger vessels, however, may persist for years.
Cervix and Lower Uterine Segment

The cervical opening contracts slowly. By the end of the first week, it has narrowed. As the opening narrows, the cervix thickens, and a canal reforms. At the completion of involution, the external os remains somewhat wider than before pregnancy with bilateral depressions at the site of lacerations.

The lower uterine segment contracts and retracts, but not as forcefully as the body of the uterus. Over the course of a few weeks, the lower segment is converted into uterine isthmus located between the uterine corpus and the internal cervical os.
Two days after delivery, the uterus begins to shrink, and within 2 weeks it has descended into the cavity of the pelvis. It regains its nonpregnant size about 4 weeks after delivery. The total number of muscle cells does not decrease appreciably, but instead, the individual cells decrease markedly in size.

In primiparas, the puerperal uterus remains tonically contracted, whereas in multiparas, the uterus often contracts vigorously at intervals, giving rise to afterpains.
Lochia

Early in the puerperium, sloughing of decidual tissue results in a vaginal discharge of variable quantity; this is termed *lochia*. It consists of erythrocytes, shredded decidua, epithelial cells and bacteria.

*lochia rubra*: For the first few days, there is blood sufficient to color it red.

*lochia serosa*: After 3 or 4 days, lochia becomes progressively pale in color.

*lochia alba*: After about the 10th day, due to leukocytes and reduced fluid content, lochia assumes a white or yellowish-white color.

Lochia persists for up to 4-8 weeks after delivery.
Endometrial Regeneration

Within 2 or 3 days after delivery, the remaining decidua becomes differentiated into two layers. The superficial layer becomes necrotic, and it is sloughed in the lochia. The basal layer remains intact and is the source of new endometrium.

The endometrium arises from proliferation of the endometrial glandular remnants and the stroma of the interglandular connective tissue.

Endometrial regeneration is rapid, except at the placental site. The entire endometrium is restored by the third week. Histological endometritis is part of the normal reparative process.
Placental Site Involution

It takes up to 6 weeks. Within hours of delivery, the placental site normally consists of many thrombosed vessels that ultimately undergo organization. Sloughing of infarcted and necrotic superficial tissues is followed by a reparative process. Exfoliation consists of both extension and „downgrowth” of endometrium from the margins of the placental site and the development of endometrial tissue from the glands and stroma that are left deep in the decidua basalis after placental separation.
Placental Site Involution

- At delivery
- 8 hours postpartum
- 8 days postpartum
- 14 days postpartum
- 17 Days postpartum
- 24 Days postpartum
- 120 Days postpartum
Subinvolution

This term describes an arrest or retardation of involution.

Symptoms: prolongation of lochial discharge, irregular or excessive uterine bleeding
On bimanual examination, the uterus is larger and softer than would be expected.

Some causes of subinvolution are retention of placental fragments and pelvic infection.
Late postpartum hemorrhage can be associated with noninvulated uteroplacental arteries.
Late Postpartum Hemorrhage

Uterine bleeding after the first postpartum day. Serious uterine hemorrhage occasionally develops 1 to 2 weeks into the puerperium. It can be the result of abnormal involution of the placental site. It may also be caused by retention of a portion of the placenta (placental polyp).

Initial treatment may be best directed to medical control of the bleeding with intravenous oxytocin, ergotamine, or prostaglandins. Curettage is carried out only if appreciable bleeding persists or recurs after medical management.
Late Postpartum Hemorrhage

Normal uterus 12 days after delivery

Placental retention
Urinary tract changes

The puerperal bladder has an increased capacity and a relative insensitivity to intravesical fluid pressure. Overdistention, incomplete emptying, and excessive residual urine are common. The dilated ureters and renal pelves return to their prepregnant state over the course of 2 to 8 weeks after delivery. Urinary tract infection is thus a concern because residual urine and bacteriuria in a traumatized bladder, coupled with the dilated renal pelves and ureters, create optimal conditions for development of infection.
3 to 26% of women report daily episodes of incontinence in the 3 to 6 months after delivery. 7% of women report the development of stress incontinence after delivery, which correlated with obstetrical factors such as length of second-stage labor, infant head circumference, birthweight, and episiotomy.

Pathophysiology: impaired muscle function in or around the urethra as a result of vaginal delivery

Women whose deliveries had all been vaginal had a 70-percent higher risk of incontinence than women whose deliveries had all been by cesarean.
Vaginal outlet relaxation and uterine prolapse

Extensive lacerations of the perineum during delivery are followed by relaxation of the vaginal outlet. Even when external lacerations are not visible, stretching may lead to marked relaxation. Moreover, changes in pelvic support during parturition predispose to uterine prolapse and to urinary stress incontinence. In general, operative correction is postponed until childbearing is ended, unless serious disability.
Uterine prolapse
Peritoneum and abdominal wall

As a result of the rupture of elastic fibers in the skin and the prolonged distention caused by the pregnant uterus, the abdominal wall remains soft and flaccid. Several weeks are required for these structures to return to normal. Recovery is aided by exercise. Except for silvery striae, the abdominal wall usually resumes its prepregnancy appearance. When muscles remain atonic, however, the abdominal wall also remains lax. There may be a marked separation of the rectus muscles (*diastasis recti*).
Blood and fluid changes

- Leukocytosis and thrombocytosis occur during and after labor. The leukocyte count sometimes reaches 30,000/µL, with the increase predominantly from granulocytes.
- During the first few postpartum days, hemoglobin concentration and hematocrit fluctuate moderately.
- By 1 week after delivery, the blood volume has returned nearly to its nonpregnant level. The cardiac output remains elevated for at least 48 hours postpartum.
- By 2 weeks, these changes have returned to normal nonpregnant values.
- Pregnancy-induced changes in blood coagulation factors persist for variable periods during the puerperium.
Changes in the circulation
Weight Loss

In addition to the loss of about 5 to 6 kg due to uterine evacuation and normal blood loss, there is usually a further decrease of 2 to 3 kg through diuresis. Most women approach their self-reported prepregnancy weight 6 months after delivery but still retain an average surplus of 1.5 kg.
Breast feeding

Colostrum

After delivery, the breasts begin to secrete colostrum, which is a deep lemon-yellow-colored liquid. Compared with mature milk, colostrum contains more minerals and protein, much of which is globulin, but less sugar and fat. Colostrum secretion persists for about 5 days. Its content of immunoglobulin A (IgA) may offer protection for the newborn against enteric pathogens. Other host resistance factors that are found in colostrum and milk include complement, macrophages, lymphocytes, lactoferrin, lactoperoxidase, and lysozymes.
Breast feeding

Milk

- Human milk is a suspension of fat and protein in a carbohydrate-mineral solution.
- A nursing mother easily makes 600 mL of milk per day.
- Milk is isotonic with plasma, with lactose accounting for half of the osmotic pressure.
- Major proteins, including α-lactalbumin, β-lactoglobulin, and casein, are also present.
- Essential and non essential amino acids.
- Contains large amounts of interleukin-6 (IL-6)
- *Prolactin and epidermal growth factor (EGF)* have also been identified.
- All vitamins except K are found in human milk.
Endocrinology of Lactation

- Progesterone, estrogen, and placental lactogen, as well as prolactin, cortisol, and insulin, appear to act in concert to stimulate the growth and development of the milk-secreting apparatus.
- With delivery, there is an abrupt and profound decrease in the levels of progesterone and estrogen, which removes the inhibitory influence of progesterone.
- A stimulus from the breast curtails the release of prolactin-inhibiting factor from the hypothalamus, and transiently induces increased prolactin secretion.
- The neurohypophysis secretes oxytocin in pulsatile fashion. This stimulates milk expression from a lactating breast. Milk ejection (*letting down*) is a reflex initiated especially by suckling, which stimulates oxytocin secretion.
Endocrinology of Lactation
Histological changes
Immunological Consequences of Breast Feeding

The predominant immunoglobulin in milk is secretory IgA. IgA exerts its action by preventing bacterial adherence to epithelial cell surfaces, thus preventing tissue invasion.

Milk contains both T and B lymphocytes. Memory T cells seem to be another mechanism by which the neonate benefits from maternal immunological experience.

IL-6 is present and appears to stimulate an increase in mononuclear cells in breast milk.
Nursing

Human milk is ideal food for neonates. It provides species- and age-specific nutrients for the infant. It has antibacterial properties and contains immunological factors and factors that promote cellular growth and differentiation.

Vitamin K and D supplementation is recommended for infants who are breast fed exclusively.

For both mother and infant, the benefits of breast feeding are likely long-term (lower risk of breast cancer, increased adult intelligence).

65 percent of women who have undergone augmentation mammoplasty have lactation insufficiency.
Protective Effects of Human Milk and Breast Feeding on Infants

Strong evidence:
diarrhea, lower respiratory infection, otitis media, bacteremia, bacterial meningitis, botulism, urinary tract infection, necrotizing enterocolitis

Possible protective effect:
sudden infant death syndrome, insulin-dependent diabetes mellitus, Crohn disease, ulcerative colitis, lymphoma, allergic diseases, other chronic digestive diseases

Possible enhancement of cognitive development
BREASTFEEDING
It Rocks!
Contraception for breast feeding women

If the woman does not nurse her child, menses usually return within 6 to 8 weeks. In lactating women, the first period may occur 2-18 months after delivery.

Ovulation is much less frequent in women who breast feed compared with those who do not. However, the risk of pregnancy in breast feeding women is 4% per year.

Progestin-only contraceptives (mini-pills and depot medroxyprogesterone) do not affect the quality or decrease milk volume. They are preferred along with IUDs.

Combined estrogen-progestin contraceptives have been shown to reduce the quantity and quality of breast milk.
Contraindications to breast feeding

- street drugs
- excessive alcohol use
- infant with galactosemia
- active, untreated tuberculosis
- take certain medications (cytotoxic drugs, lithium)
- treatment for breast cancer
- human immunodeficiency virus (HIV) infection
Breast Fever

For the first 24 hours after commencement of lactation, it is not unusual for the breasts to become distended, firm, and nodular. *Breast engorgement* may be accompanied by a transient elevation of temperature. 13 percent of all postpartum women have fever that ranged from 37.8 to 39°C from this cause.

Other causes of fever, especially those due to infection, must be excluded.

Treatment consists of supporting the breasts with a binder or brassiere, applying an ice bag, and an analgesic. Pumping of the breast may be necessary.
Mastitis

It is estimated to occur from 2 to 33 percent of breast feeding women. Infection almost invariably is unilateral, preceded by marked engorgement.

Symptoms: chills or actual rigor, soon followed by fever and tachycardia. The breast becomes hard and reddened, and the woman complains of severe pain. 10% of women with mastitis develop an abscess (fluctuation, US).
Mastitis

The most commonly isolated organism is *Staphylococcus aureus*. Other commonly isolated organisms are coagulase-negative staphylococci and viridans streptococci.

The source of these organisms is the infant’s nose and throat. The infecting organism can usually be cultured from milk.

Even staphylococcal infections are usually sensitive to penicillin or a cephalosporin. Erythromycin is given to women who are penicillin sensitive. Vancomycin is effective against MRSA. Treatment is necessary for 10-14 days.

Breast feeding should be continued or gently pumping is recommended.

Traditional therapy of *breast abscess* is surgical drainage, which usually requires general anesthesia.
Puerperal fever

Puerperal infection is a general term used to describe any bacterial infection of the genital tract after delivery. Along with preeclampsia and obstetrical hemorrhage, puerperal infection formed the lethal triad of causes of maternal deaths for many decades of the 20th century. In the US, infection made up 13 percent of pregnancy-related deaths and was the fifth leading cause of death.

Puerperal fever is defined as follows: a temperature of 38.0°C or higher, which occurs on any 2 of the first 10 days postpartum, exclusive of the first 24 hours, and which is taken orally by a standard technique at least four times daily.
Puerperal fever

![Graph showing yearly mortality rates for puerperal fever from 1841 to 1846. The graph compares mortality rates between the First clinic and the Second clinic.](image)

![Graph showing monthly mortality rates for puerperal fever from 1841 to 1849. The graph includes a note on chlorine handwash.](image)
Puerperal fever
differential diagnosis

- genital tract infection
- breast engorgement, mastitis
- atelectasis
- aspiration pneumonia
- bacterial pneumonia
- acute pyelonephritis
- thrombophlebitis
The preferred term is *metritis with pelvic cellulitis*. The route of delivery is its most significant risk factor.

**Vaginal Delivery**

Metritis following vaginal delivery is relatively uncommon. The incidence is nearly 6 percent in women with prolonged membrane rupture and labor, multiple cervical examinations, and internal fetal monitoring.

If there is intrapartum chorioamnionitis, the risk of infection increases to 13 percent.

Other risk factors for metritis are stillbirth, low birthweight, preterm delivery, and serious neonatal morbidity.
Uterine infection

Cesarean Delivery
The incidence of metritis following surgical delivery varies with socioeconomic factors, and over the years this has been altered substantively by almost universal use of perioperative antimicrobials.

The use of single-dose perioperative antimicrobial prophylaxis has done more to decrease the incidence and severity of postcesarean delivery pelvic infections than any other innovation in the past 25 years.

Women whose infants were delivered for cephalopelvic disproportion, and who were not given perioperative prophylaxis had an incidence of serious pelvic infection that was nearly 90 percent.
Uterine infection

Other Risk Factors

• Anemia
• Malnutrition
• Bacterial colonization: group B streptococcus, Chlamydia trachomatis, Mycoplasma hominis, Gardnerella vaginalis and Ureaplasma urealyticum
• Multifetal gestation
• Young maternal age and nulliparity
• Prolonged labor induction
• Obesity
• Meconium-stained amnionic fluid
Bacterial contamination
- Indigenous vaginal flora

Inoculation and colonization of lower uterine segment, incisions, and lacerations
- Vaginal examinations
- Internal electronic monitoring
- Prolonged labor
- Uterine incision

Favorable anaerobic bacterial conditions
- Surgical trauma
- Foreign body
- Devitalized tissue
- Blood and serum collection

Polymicrobial proliferation with tissue invasion

Metritis
Bacteria commonly responsible for puerperal infections

<table>
<thead>
<tr>
<th>Aerobes</th>
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<tbody>
<tr>
<td>Group A, B, and D streptococci</td>
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<tr>
<td>Enterococcus</td>
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<tr>
<td>Gram-negative bacteria—<em>Escherichia coli</em>,</td>
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<tr>
<td><em>Klebsiella</em>, and <em>Proteus</em> species</td>
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<tr>
<td><em>Staphylococcus aureus</em></td>
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<tr>
<td><em>Staphylococcus epidermidis</em></td>
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<tr>
<td><em>Gardnerella vaginalis</em></td>
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<td>Anaerobes</td>
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<tr>
<td><em>Peptococcus</em> species</td>
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<td><em>Peptostreptococcus</em> species</td>
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<tr>
<td><em>Bacteroides fragilis</em> group</td>
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<td><em>Prevotella</em> species</td>
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<td><em>Clostridium</em> species</td>
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<td><em>Fusobacterium</em> species</td>
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<tr>
<td><em>Mobiluncus</em> species</td>
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<tr>
<td>Other</td>
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<tr>
<td><em>Mycoplasma</em> species</td>
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<tr>
<td><em>Chlamydia trachomatis</em></td>
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<tr>
<td><em>Neisseria gonorrhoeae</em></td>
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Clinical course of metritis

- Fever is the most important criterion for the diagnosis of postpartum metritis.
- Chills may accompany fever and suggest bacteremia.
- Women usually complain of abdominal pain, and parametrial tenderness.
- An offensive odor may develop.
- Leukocytosis may range from 15,000 to 30,000 cells/µL.
**Management**

- If mild metritis develops after the woman has been sent home following vaginal delivery, treatment with an oral antimicrobial agent is usually sufficient.
- For moderate to severe infections, however, including those following cesarean delivery, intravenous therapy with a broad-spectrum antimicrobial regimen is indicated.
- Complications of metritis that cause persistent fever despite appropriate therapy include a parametrial phlegmon or an area of intense cellulitis, a surgical incisional or pelvic abscess, an infected hematoma, and septic pelvic thrombophlebitis.
Specific antimicrobial treatment of metritis

- Therapy is empirical.
- Initial treatment is broad-spectrum antimicrobial coverage.
- 90 percent of infections following vaginal delivery respond to regimens such as ampicillin plus gentamicin.
- Women given the clindamycin-gentamicin regimen had a 95-percent rate of infection resolution.
- Because of enterococcal infections, many add ampicillin to the clindamycin-gentamicin regimen, either initially or if there is no response by 48 to 72 hours.
- *Metronidazole* has superior in vitro activity against most anaerobes, and it may be given with ampicillin and an aminoglycoside in serious pelvic infections.
- *Imipenem + cilastatin* is reserved for more serious infections.
Prevention of infection

• The use of perioperative antimicrobial prophylaxis reduces the rate of puerperal endometritis by 70 to 80 percent.

• Single agents such as ampicillin and first-generation cephalosporins are ideal prophylactic antimicrobials.

• Antepartum treatment of asymptomatic women with vaginal infections has not been shown to prevent postpartum metritis.
Complications of pelvic infections

WOUND INFECTIONS

• The incidence of abdominal incisional infections following cesarean delivery ranges from 3 to 15 percent, with an average of about 6 percent. When prophylactic antimicrobials are given, the incidence is less than 2 percent.

• Wound infection is the most common cause of antimicrobial failure in women treated for metritis. Risk factors include obesity, diabetes, corticosteroid therapy, immunosuppression, anemia, and poor hemostasis with hematoma formation.

• In case of abdominal incisional abscesses, the treatment includes antimicrobials and surgical drainage.
Complications of pelvic infections

WOUND INFECTIONS

• *Necrotizing fasciitis* is the most serious form of wound infections with high mortality.
• It may involve abdominal incisions following SC or may complicate episiotomy or perineal lacerations.
• Risk factors: diabetes, obesity, hypertension
• Infections are more commonly polymicrobial.
• Treatment includes resection of the necrotic tissue along with a broad-spectrum antimicrobial regimen.
Complications of metritis
Complications of pelvic infections

- **Parametrial phlegmon** develops if parametrial cellulitis is intensive and forms an area of induration.
- It may extend laterally to the lateral pelvic wall or posteriorly to the rectovaginal septum.
- In most women, clinical improvement follows continued treatment with a broad-spectrum antimicrobial regimen.
- Surgery is reserved for women in whom uterine incisional necrosis is suspected (hysterectomy and surgical debridement).
- **Pelvic abscess** is formed if a parametrial phlegmon suppurates. Surgical drainage is required.
- **Infected hematomas** also require drainage.
- **Adnexal infections and peritonitis** rarely develop from puerperal infection.
Complications of pelvic infections

SEPTIC PELVIC THROMBOPHLEBITIS

• Puerperal infection may extend along venous routes and cause thrombosis. Lymphangitis often coexists.
• It frequently involves one or both ovarian venous plexuses. The clot may extend into the inferior vena cava.
• Clinical findings: persistent fever with chills, pain and a tender mass lateral to the uterine cornu on either side (ovarian vein thrombophlebitis)
• Diagnosis: pelvic CT with contrast, MRI
• Treatment: continued antimicrobial therapy
• The addition of heparin did not hasten recovery or improve outcome.
Infections of the perineum, vagina and cervix

- Episiotomy infections are not often. With infection, dehiscence is a concern.
- Vaginal and cervical lacerations may become infected. Parametrial extension may result in lymphangitis and parametritis.
- In case of infected episiotomies, sutures are removed and the infected wound opened.
- Prior to attempting early repair of episiotomy dehiscence, the surgical wound must be properly cleaned and free of infection.
- *Necrotizing fasciitis* may complicate perineal and vaginal wound infections. Necrotizing fasciitis of the episiotomy site may extend to the thighs, buttocks and abdominal wall.
- Treatment includes extensive debridement of all infected tissue, antimicrobials and intensive care.
Toxic shock syndrome

This acute febrile illness with severe multisystem derangement has a case-fatality rate of 10 to 15 percent.

Symptoms: fever, headache, mental confusion, diffuse macular erythematous rash, subcutaneous edema, nausea, vomiting, watery diarrhea, and marked hemoconcentration. Renal failure may be followed by hepatic failure, disseminated intravascular coagulation, and circulatory collapse.

*Staphylococcus aureus* has been recovered. Staphyloccocal exotoxin, termed *toxic shock syndrome toxin* causes the syndrome by provoking profound endothelial injury.
Staphylococcus aureus
Toxic shock syndrome

Principal therapy for toxic shock is supportive, while allowing reversal of capillary endothelial injury. In severe cases, treatment requires massive fluid replacement, mechanical ventilation with positive end-expiratory pressure, and renal dialysis.

Antimicrobial therapy with antistaphylococcal drugs is given. With evidence for uterine infection, antimicrobial therapy must include agents used for all puerperal infections.

Cases of streptococcal toxic shock syndrome often require hysterectomy.
Other complications of the puerperium

- Some degree of depressed mood a few days after delivery is fairly common. This is termed *postpartum blues*. It usually remits after 2 to 3 days. If postpartum blues persist or worsen, *major depression* should be considered.
- *Thromboembolic disease*: half of thromboembolic events associated with pregnancy develop in the puerperium.
- *Obstetrical neuropathies*: lateral femoral cutaneous neuropathies are the most common, followed by femoral neuropathies.
- *Pelvic joint separation*: separation of the symphysis pubis or one of the sacroiliac synchondroses during labor may be followed by pain and interference with locomotion.
- Treatment is conservative, with rest and a pelvic binder.