

Vaginal discharge

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Vaginal discharge is a mixture of liquid, cells, and bacteria that lubricates and protects the vagina.^[1] This mixture is constantly produced by the cells of the

vagina and cervix and it exits the body through the vaginal opening. The composition, amount, and quality of discharge varies between individuals as well as through the various stages of sexual and reproductive development.^[2] Normal vaginal discharge may have a thinner, watery consistency or a thick, sticky consistency, and may be clear or white in color.^[1] Normal vaginal discharge may be large in volume but typically does not have a strong odor, nor is it typically associated with itching or pain.^[2] While most discharge represents normal functioning of the body, some changes in discharge can reflect infection or other pathological processes.^{[3][4]} Infections that may cause changes in vaginal discharge include vaginal yeast infections, bacterial vaginosis, and sexually transmitted infections.^[5] The characteristics of abnormal vaginal discharge vary depending on the cause, but common features include a change in color, a foul odor, and associated symptoms such as itching, burning, pelvic pain, or pain during sexual intercourse.^[6]

Vaginal discharge

Classification and external resources

DiseasesDB	28137 (http://www.diseasesdatabase.com/ddb28137.htm)
MedlinePlus	003158 (https://medlineplus.gov/ency/article/003158.htm)
MeSH	D019522 (https://www.nlm.nih.gov/cgi/mesh/2017/MB_cgi?field=uid&term=D019522)

Contents

- 1 Normal discharge
 - 1.1 Neonatal
 - 1.2 Pediatric
 - 1.3 Puberty
 - 1.4 Menstrual cycle
 - 1.5 Pregnancy
 - 1.6 Menopause
- 2 Abnormal discharge
 - 2.1 Bacterial vaginosis
 - 2.2 Vaginal yeast infection
 - 2.3 Trichomonas vaginitis
 - 2.4 Chlamydia and gonorrhea
 - 2.5 Other causes
 - 2.6 Before puberty
- 3 See also
- 4 References

Normal discharge

Normal vaginal discharge is composed of cervical mucus, vaginal fluid, shedding vaginal and cervical cells, and bacteria.^[1]

The majority of the liquid in vaginal discharge is mucus produced by glands of the cervix.^{[1][3]} The rest is made up of transudate from the vaginal walls and secretions from glands (Skene's and Bartholin's).^[3] The solid components are exfoliated epithelial cells from the vaginal wall and cervix as well as some of the bacteria that inhabit the vagina.^[1] These bacteria that live in the vagina do not typically cause disease. In fact, they can protect the individual from other infectious and invasive bacteria by producing substances such as lactic acid and hydrogen peroxide that inhibit growth of other bacteria.^[5] The normal

composition of bacteria in the vagina (vaginal flora) can vary, but is most commonly dominated by lactobacilli.^[1] On average, there are approximately 10^8 to 10^9 bacteria per milliliter of vaginal discharge.^{[1][3]}

Normal vaginal discharge is clear, white, or off-white.^[1] The consistency can range from milky to clumpy, and odor typically mild to non-existent.^[1] The majority of the discharge pools in the deepest portion of the vagina (the posterior fornix)^[2] and exits the body over the course of a day with the force of gravity.^{[1][3]} A typical reproductive-age woman produces 1.5 grams (half to one teaspoon) of vaginal discharge every day.^[1]

During sexual arousal and intercourse, the amount of fluid in the vagina increases due to engorgement of blood vessels surrounding the vagina. This engorgement of blood vessels increases the volume of transudate from the vaginal walls.^[3] Transudate has a neutral pH, so increases in its production can temporarily shift vaginal pH to be more neutral.^[3] Semen has a basic pH and can neutralize the acidity of the vagina for up to 8 hrs.^[3]

The composition and amount of vaginal discharge changes as an individual goes through the various stages of sexual and reproductive development.^[3]

Neonatal



Normal vagina and cervix during a medical speculum exam demonstrating IUD strings at the opening of the cervix and normal milky white vaginal discharge on the vaginal walls, cervix, and pooled in vaginal fornix.

In neonates, vaginal discharge sometimes occurs in the first few days after birth. This is due to exposure to estrogen while in utero. Neonatal vaginal discharge may be white or clear with a mucous texture, or it may be bloody from normal transient shedding of the endometrium.^[7]

Pediatric

The vagina of girls before puberty is thinner and has a different bacterial flora.^{[1][3]} Vaginal discharge in pre-pubertal girls is minimal with a neutral to alkaline pH ranging from 6 to 8.^[8] The composition of the bacterial population in pre-pubertal girls is dominated by staphylococcus species, in addition to a range of anaerobes, enterococci, *E. coli*, and lactobacillus.^[8]

Puberty

During puberty, the hormone estrogen begins to be produced by the ovaries.^[2] Even before the beginning of menses (up to 12 months before menarche, typically at the same time as the development of breast buds,^[3]) vaginal discharge increases in amount and changes in composition.^[8] Estrogen matures vaginal tissues and causes increased production of glycogen by epithelial cells of the vagina.^[1] These higher levels of glycogen in the vaginal canal support the growth of lactobacilli over other bacterial species.^{[1][2]} When lactobacilli use glycogen as a food source, they convert it to lactic acid.^{[1][2][3]} Therefore, the predominance of lactobacilli in the vaginal canal creates a more acidic environment. In fact, the pH of the vagina and vaginal discharge after puberty ranges between 3.5 and 4.7.^[1]

Menstrual cycle

The amount and consistency of vaginal discharge changes as the menstrual cycle progresses.^[9] In the days right after menstruation, vaginal discharge is minimal and its consistency is thick and sticky.^[10] When approaching ovulation, the rising estrogen levels cause a concomitant increase in vaginal discharge.^[10] The increase in the amount of discharge at ovulation is 30 times greater than the amount produced directly following menstruation.^[10] The discharge also changes in color and consistency during this time, becoming clear with an elastic consistency.^[10] After ovulation the body's progesterone levels increase, which causes a decrease in the amount of vaginal discharge.^[10] The consistency of the discharge once again becomes thick and sticky and opaque in color.^[10] The discharge continues to decrease from the end of ovulation until the end of menstruation, and then after menstruation it begins its rise again.^[10]

Pregnancy

During pregnancy, vaginal discharge volume increases as a result of the body's increased levels of estrogen and progesterone.^[11] The discharge is usually white or slightly gray, and may have a musty smell.^[11] The normal discharge of pregnancy does not contain blood or cause itching.^[11] The pH of the vaginal discharge in pregnancy tends to be more acidic than normal due to increased production of lactic acid.^[11] This acidic environment helps to provide protection from many infections, though conversely it also makes women more susceptible to vaginal yeast infections.^[11]

Menopause

With the drop in estrogen levels that comes with menopause, the vagina returns to a state similar to pre-puberty.^[7] Specifically, the vaginal tissues thin, become less elastic; blood flow to the vagina decreases; the surface epithelial cells contain less glycogen.^[7] With decreased levels of glycogen, the vaginal

flora shifts to contain fewer lactobacilli, and the pH subsequently decreases to a range of 6.0-7.5.^[7] The overall amount of vaginal discharge decreases in menopause. While this is normal, it can lead to symptoms of dryness and pain during penetrative sexual intercourse.^[12] These symptoms can often be treated with vaginal moisturizers/lubricants or vaginal hormone creams.^[13]

Abnormal discharge

Abnormal discharge can occur in a number of conditions, including infections and imbalances in vaginal flora or pH. Abnormal vaginal discharge may also not have a known cause. In one study looking at women presenting to clinic with concerns about vaginal discharge or a foul smell in their vagina, it was found that 34% had bacterial vaginosis and 23% had vaginal candidiasis (yeast infection).^[6] 32% of patients were found to have sexually transmitted infections including Chlamydia, Gonorrhea, Trichomonas, or Genital Herpes.^[6] Diagnosing the cause of abnormal vaginal discharge can be difficult, though a potassium hydroxide test or vaginal pH analysis may be used. When abnormal discharge occurs with burning, irritation, or itching on the vulva, it is called vaginitis.^[7] The most common causes of pathological vaginal discharge in adolescents and adults are described below.

Bacterial vaginosis

Bacterial vaginosis (BV) is an infection caused by a change in the vaginal flora, which refers to the community of organisms that live in the vagina.^[14] It is the most common cause of pathological vaginal discharge in women of childbearing age and accounts for 40-50% of cases.^[15] In BV, the vagina experiences a decrease in a bacteria called lactobacilli, and a relative increase in a multitude of anaerobic bacteria with the most predominant being *Gardnerella vaginalis*.^[16] This imbalance results in the characteristic vaginal discharge experienced by patients with BV.^[14] The discharge in BV has a characteristic strong fishy odor, which is caused by the relative increase in

anaerobic bacteria.^[1] The discharge is typically thin and grey, or occasionally green.^{[14][16]} It sometimes is accompanied by burning with urination. Itching is rare.^[17] The exact reasons for the disruption of vaginal flora leading to BV are not fully known.^[18] However, factors associated with BV include antibiotic use, unprotected sex, douching, and using an intrauterine device (IUD).^[19] The role of sex in BV is unknown, and BV is not considered an STD.^[14] The diagnosis of BV is made by a health care provider based on the appearance of the discharge, discharge pH > 4.5, presence of clue cells under the microscope, and a characteristic fishy odor when the discharge is placed on a slide and combined with potassium hydroxide ("whiff test").^{[14][16]} The gold standard for diagnosis is a gram stain showing a relative lack of lactobacilli and a polymicrobial array of gram negative rods, gram variable rods, and cocci. BV may be treated with oral or intravaginal antibiotics, or oral or intravaginal lactobacillus.^[20]

Vaginal yeast infection

A vaginal yeast infection results from overgrowth of candida albicans, or yeast, in the vagina.^[21] This is a relatively common infection, with over 75% of women having experienced at least one yeast infection at some point in their life.^[22] Risk factors for yeast infections include recent antibiotic use, diabetes, immunosuppression, increased estrogen levels, and use of certain contraceptive devices including intrauterine devices, diaphragms, or sponges.^{[21][23]} It is not a sexually transmitted infection. Candida vaginal infections are common; an estimated 75% of women will have at least one yeast infection in their lifetime.^[23] Vaginal discharge is not always present in yeast infections, but when occurring it is typically odorless, thick, white, and clumpy.^[21] Vaginal itching is the most common symptom of candida vulvovaginitis.^[21] Women may also experience burning, soreness, irritation, pain during urination, or pain during sex.^[23] The diagnosis of Candida vulvovaginitis is made by looking at a sample taken from the vagina under the microscope that

shows hyphae (yeast), or from a culture.^[24] It is important to note that the symptoms described above may be present in other vaginal infections, so microscopic diagnosis or culture is needed to confirm the diagnosis.^[23] Treatment is with intra-vaginal or oral anti-fungal medications.^[23]

Trichomonas vaginitis

Trichomonas vaginitis is an infection acquired through sex that is associated with vaginal discharge.^[21] It can be transmitted by way of the penis to the vagina, the vagina to the penis, or from vagina to vagina.^[25] The discharge in Trichomonas is typically yellowish-green in color.^[21] It sometimes is frothy and can have a foul smell.^[26] Other symptoms may include vaginal burning or itching, pain with urination, or pain with sexual intercourse.^[25] Trichomonas is diagnosed by looking at a sample of discharge under the microscope showing trichomonads moving on the slide.^[21] However, in women with trichomonas the organism is typically detected in only 60-70% of cases.^[21] Other testing, including a culture of the discharge or a PCR assay, are more likely to detect the organism.^[21] Treatment is with a one time dose of oral antibiotics, most commonly metronidazole or tindazole.^[21]

Chlamydia and gonorrhea

Chlamydia and gonorrhea can also cause vaginal discharge, though more often than not these infections do not cause symptoms.^[26] The vaginal discharge in Chlamydia is typically pus-filled, but it is important to note that in around 80% of cases Chlamydia does not cause any discharge.^[26] Gonorrhea can also causes a pus-filled vaginal discharge, but Gonorrhea is similarly asymptomatic in up to 50% of cases.^[26] If the vaginal discharge is accompanied by pelvic pain, this is suggestive of pelvic inflammatory disease, a condition in which the bacteria have moved up the reproductive tract.^[26]

Other causes

Foreign objects can cause a chronic vaginal discharge with a foul odor.^[27] Common foreign objects found in adolescents and adults are tampons, toilet paper, and objects used for sexual arousal.^[27]

Before puberty

The most common reason pre-pubertal females go to the gynecologist is concern about vaginal discharge and vaginal odor.^[28] The causes of abnormal vaginal discharge in pre-pubertal girls is different than adults and is usually related to lifestyle factors such as irritation from harsh soaps or tight clothing.^[28] The vagina of pre-pubertal girls (due to lack of estrogen) is thin-walled and has a different microbiota; additionally, the vulva in pre-pubertal girls lacks pubic hair. These features makes the vagina more prone to bacterial infection.^[28] The bacteria that are more commonly responsible for vaginal discharge in pre-pubertal girls is unique from other age groups, and includes Bacteriodes, Peptostreptococcus, and Candida (yeast). This can result from the colonization of the vagina with oral or fecal bacteria.^[29] Another cause of vaginal discharge in pre-pubertal girls is the presence of a foreign object such as a toy or a piece of toilet paper.^[27] In the case of a foreign body, the discharge is often bloody or brown.^[27]

See also

- Vaginal lubrication
- Bartholin's gland
- Vaginal flora
- Vaginal microbiota in pregnancy

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