

= Cervix =

The cervix or cervix uteri (Latin : neck of the uterus) is the lower part of the uterus in the human female reproductive system . In a non @-@ pregnant woman , the cervix is usually 2 to 3 cm long (~ 1 inch) and roughly cylindrical in shape . The narrow , central cervical canal runs along its entire length , connecting the uterine cavity and the lumen of the vagina . The opening into the uterus is called the internal os , and the opening into the vagina is called the external os . The lower part of the cervix , known as the vaginal portion of the cervix (or ectocervix) , bulges into the top of the vagina . The cervix has been documented anatomically since at least the time of Hippocrates , over 2 @,@ 000 years ago .

The cervical canal is a passage through which sperm must travel to fertilize an egg cell after sexual intercourse . Several methods of contraception , including cervical caps and cervical diaphragms aim to block or prevent the passage of sperm through the cervical canal . Cervical mucus is used in several methods of fertility awareness , such as the Creighton model and Billings method , due to its changes in consistency throughout the menstrual period . During vaginal childbirth , the cervix must flatten and dilate to allow the fetus to progress along the birth canal . Midwives and doctors use the extent of the dilation of the cervix to assist decision @-@ making during childbirth .

The endocervical canal is lined with a single layer of column @-@ shaped cells , while the ectocervix is covered with multiple layers of cells topped with flat cells . The two types of epithelia meet the squamocolumnar junction . Infection with the human papillomavirus (HPV) can cause changes in the epithelium , which can lead to cancer of the cervix . Cervical cytology tests can often detect cervical cancer and its precursors , and enable early successful treatment . Ways to avoid HPV include avoiding sex , using condoms , and HPV vaccination . HPV vaccines , developed in the early 21st century , reduce the risk of cervical cancer by preventing infections from the main cancer @-@ causing strains of HPV .

= = Structure = =

The cervix is part of the female reproductive system . Around 2 ? 3 centimetres (0 @.@ 8 ? 1 @.@ 2 in) in length , it is the lower narrower part of the uterus continuous above with the broader upper part ? or body ? of the uterus . The lower end of the cervix bulges through the anterior wall of the vagina , and is referred to as the vaginal portion of cervix (or ectocervix) while the rest of the cervix above the vagina is called the supravaginal portion of cervix . A central canal , known as the cervical canal , runs along its length and connects the cavity of the body of the uterus with the lumen of the vagina . The openings are known as the internal os and external orifice of the uterus (or external os) respectively . The mucosa lining the cervical canal is known as the endocervix , and the mucosa covering the ectocervix is known as the exocervix . The cervix has an inner mucosal layer , a thick layer of smooth muscle , and posteriorly the supravaginal portion has a serosal covering consisting of connective tissue and overlying peritoneum .

In front of the upper part of the cervix lies the bladder , separated from it by cellular connective tissue known as parametrium , which also extends over the sides of the cervix . To the rear , the supravaginal cervix is covered by peritoneum , which runs onto the back of the vaginal wall and then turns upwards and onto the rectum , forming the recto @-@ uterine pouch . The cervix is more tightly connected to surrounding structures than the rest of the uterus .

The cervical canal varies greatly in length and width between women or over the course of a woman 's life , and it can measure 8 mm (0 @.@ 3 inch) at its widest diameter in premenopausal adults . It is wider in the middle and narrower at each end . The anterior and posterior walls of the canal each have a vertical fold , from which ridges run diagonally upwards and laterally . These are known as palmate folds , due to their resemblance to a palm leaf . The anterior and posterior ridges are arranged in such a way that they interlock with each other and close the canal . They are often effaced after pregnancy .

The ectocervix (also known as the vaginal portion of the cervix) has a convex , elliptical shape and projects into the cervix between the anterior and posterior vaginal fornices . On the rounded part of

the ectocervix is a small , depressed external opening , connecting the cervix with the vagina . The size and shape of the ectocervix and the external opening (external os) can vary according to age , hormonal state , and whether natural or normal childbirth has taken place . In women who have not had a vaginal delivery , the external opening is small and circular , and in women who have had a vaginal delivery , it is slit @-@ like . On average , the ectocervix is 3 cm (1 @.@ 2 in) long and 2 @.@ 5 cm (1 in) wide .

Blood is supplied to the cervix by the descending branch of the uterine artery and drains into the uterine vein . The pelvic splanchnic nerves , emerging as S2 ? S3 , transmit the sensation of pain from the cervix to the brain . These nerves travel along the uterosacral ligaments , which pass from the uterus to the anterior sacrum .

Three channels facilitate lymphatic drainage from the cervix . The anterior and lateral cervix drains to nodes along the uterine arteries , travelling along the cardinal ligaments at the base of the broad ligament to the external iliac lymph nodes and ultimately the paraaortic lymph nodes . The posterior and lateral cervix drains along the uterine arteries to the internal iliac lymph nodes and ultimately the paraaortic lymph nodes , and the posterior section of the cervix drains to the obturator and presacral lymph nodes . However , there are variations as lymphatic drainage from the cervix travels to different sets of pelvic nodes in some people . This has implications in scanning nodes for involvement in cervical cancer .

After menstruation and directly under the influence of estrogen , the cervix undergoes a series of changes in position and texture . During most of the menstrual cycle , the cervix remains firm , and is positioned low and closed . However , as ovulation approaches , the cervix becomes softer and rises to open in response to the higher levels of estrogen present . These changes are also accompanied by changes in cervical mucus , described below .

= = = Development = = =

As a component of the female reproductive system , the cervix is derived from the two paramesonephric ducts (also called Müllerian ducts) , which develop around the sixth week of embryogenesis . During development , the outer parts of the two ducts fuse , forming a single urogenital canal that will become the vagina , cervix and uterus . The cervix grows in size at a smaller rate than the body of the uterus , so the relative size of the cervix over time decreases , decreasing from being much larger than the body of the uterus in fetal life , twice as large during childhood , and decreasing to its adult size , smaller than the uterus , after puberty . Previously it was thought that during fetal development , the original squamous epithelium of the cervix is derived from the urogenital sinus and the original columnar epithelium is derived from the paramesonephric duct . The point at which these two original epithelia meet is called the original squamocolumnar junction . New studies show , however , that all the cervical as well as large part of the vaginal epithelium are derived from Müllerian duct tissue and that phenotypic differences might be due to other causes .

= = = Histology = = =

The endocervical mucosa is about 3 millimetres (0 @.@ 12 in) thick , lined with a single layer of columnar mucous cells , and contains numerous tubular mucous glands which empty viscous alkaline mucus into the lumen . In contrast , the ectocervix is covered with nonkeratinized stratified squamous epithelium , which resembles the squamous epithelium lining the vaginal . The junction between these two types of epithelia is called the squamocolumnar junction . Underlying both types of epithelium is a tough layer of collagen . The mucosa of the endocervix is not shed during menstruation . The cervix has more fibrous tissue , including collagen and elastin , than the rest of the uterus .

In prepubertal girls , the functional squamocolumnar junction is present just within the endocervical canal . Upon entering puberty , due to hormonal influence , and during pregnancy , the columnar epithelium extends outwards over the ectocervix as the cervix everts . Hence , this also causes the

squamocolumnar junction to move outwards onto the vaginal portion of the cervix , where it is exposed to the acidic vaginal environment . The exposed columnar epithelium can undergo physiological metaplasia and change to tougher metaplastic squamous epithelium in days or weeks , which when mature is very similar to the original squamous epithelium . The new squamocolumnar junction is therefore internal to the original squamocolumnar junction , and the zone of unstable epithelium between the two junctions is called the transformation zone of the cervix . After menopause , the uterine structures involute and the functional squamocolumnar junction moves into the endocervical canal .

Nabothian cysts (or Nabothian follicles) form in the transformation zone where the lining of metaplastic epithelium has replaced mucous epithelium and caused a strangulation of the outlet of some of the mucous glands . A build up of mucus in the glands forms Nabothian cysts , usually less than about 5 mm (0 @. @ 20 in) in diameter , which are considered physiological rather than pathological . Both gland openings and Nabothian cysts are helpful to identify the transformation zone .

= = Function = =

= = = Fertility = = =

The cervical canal is a pathway through which sperm enter the uterus after sexual intercourse , and some forms of artificial insemination . Some sperm remains in cervical crypts , infoldings of the endocervix , which act as a reservoir , releasing sperm over several hours and maximising the chances of fertilisation . A theory states the cervical and uterine contractions during orgasm draw semen into the uterus . Although the " upsuck theory " has been generally accepted for some years , it has been disputed due to lack of evidence , small sample size , and methodological errors .

Some methods of fertility awareness , such as the Creighton model and the Billings method involve estimating a woman 's periods of fertility and infertility by observing physiological changes in her body . Among these changes are several involving the quality of her cervical mucus : the sensation it causes at the vulva , its elasticity (Spinnbarkeit) , its transparency , and the presence of ferning .

= = = Cervical mucus = = =

Several hundred glands in the endocervix produce 20 ? 60 mg of cervical mucus a day , increasing to 600 mg around the time of ovulation . It is viscous as it contains large proteins known as mucins . The viscosity and water content varies during the menstrual cycle ; mucus is composed of around 93 % water , reaching 98 % at midcycle . These changes allow it to function either as a barrier or a transport medium to spermatozoa . It contains electrolytes such as calcium , sodium , and potassium ; organic components such as glucose , amino acids , and soluble proteins ; trace elements including zinc , copper , iron , manganese , and selenium ; free fatty acids ; enzymes such as amylase ; and prostaglandins . Its consistency is determined by the influence of the hormones estrogen and progesterone . At midcycle around the time of ovulation ? a period of high estrogen levels ? the mucus is thin and serous to allow sperm to enter the uterus , and is more alkaline and hence more hospitable to sperm . It is also higher in electrolytes , which results in the " ferning " pattern that can be observed in drying mucus under low magnification ; as the mucus dries , the salts crystallize , resembling the leaves of a fern . The mucus has stretchy character described as Spinnbarkeit most prominent around the time of ovulation .

At other times in the cycle , the mucus is thick and more acidic due to the effects of progesterone . This " infertile " mucus acts as a barrier to sperm from entering the uterus . Women taking an oral contraceptive pill also have thick mucus from the effects of progesterone . Thick mucus also prevents pathogens from interfering with a nascent pregnancy .

A cervical mucus plug , called the operculum , forms inside the cervical canal during pregnancy . This provides a protective seal for the uterus against the entry of pathogens and against leakage of

uterine fluids . The mucus plug is also known to have antibacterial properties . This plug is released as the cervix dilates , either during the first stage of childbirth or shortly before . It is visible as a blood @-@ tinged mucous discharge .

= = = Childbirth = = =

The cervix plays a major role in childbirth . As the fetus descends within the uterus in preparation for birth , the presenting part , usually the head , rests on and is supported by the cervix . As labour progresses , the cervix becomes softer and shorter , begins to dilate , and rotates to face anteriorly . The support the cervix provides to the fetal head starts to give way when the uterus begins its contractions . During childbirth , the cervix must dilate to a diameter of more than 10 cm (3 @. @ 9 in) to accommodate the head of the fetus as it descends from the uterus to the vagina . In becoming wider , the cervix also becomes shorter , a phenomenon known as effacement .

Along with other factors , midwives and doctors use the extent of cervical dilation to assist decision making during childbirth . Generally , the active first stage of labour , when the uterine contractions become strong and regular , begins when the cervical dilation is more than 3 ? 5 cm (1 @. @ 2 ? 2 @. @ 0 in) . The second phase of labor begins when the cervix has dilated to 10 cm (4 in) , which is regarded as its fullest dilation , and is when active pushing and contractions push the baby along the birth canal leading to the birth of the baby . The number of past vaginal deliveries is a strong factor in influencing how rapidly the cervix is able to dilate in labour . The time taken for the cervix to dilate and efface is one factor used in reporting systems such as the Bishop score , used to recommend whether interventions such as a forceps delivery , induction , or Caesarean section should be used in childbirth .

Cervical incompetence is a condition in which shortening of the cervix due to dilation and thinning occurs , before term pregnancy . Short cervical length is the strongest predictor of preterm birth .

= = = Contraception = = =

Several methods of contraception involve the cervix . Cervical diaphragms are reusable , firm @-@ rimmed plastic devices inserted by a woman prior to intercourse that cover the cervix . Pressure against the walls of the vagina maintain the position of the diaphragm , and it acts as a physical barrier to prevent the entry of sperm into the uterus , preventing fertilisation . Cervical caps are a similar method , although they are smaller and adhere to the cervix by suction . Diaphragms and caps are often used in conjunction with spermicides . In one year , 12 % of women using the diaphragm will undergo an unintended pregnancy , and with optimal use this falls to 6 % . Efficacy rates are lower for the cap , with 18 % of women undergoing an unintended pregnancy , and 10 ? 13 % with optimal use . Most types of progestogen @-@ only pills are effective as a contraceptive because they thicken cervical mucus making it difficult for sperm to pass along the endocervical canal . In addition , they may also sometimes prevent ovulation . In contrast , contraceptive pills that contain both oestrogen and progesterone , the combined oral contraceptive pills , work mainly by preventing ovulation . They also thicken cervical mucus and thin the lining of the uterus enhancing their effectiveness .

= = Clinical significance = =

= = = Cancer = = =

In 2008 , cervical cancer was the third @-@ most common cancer in women worldwide , with rates varying geographically from less than one to more than 50 cases per 100 @, @ 000 women . It is a leading cause of cancer @-@ related death in poor countries , where delayed diagnosis leading to poor outcomes is common . The introduction of routine screening has resulted in fewer cases of (and deaths from) cervical cancer , however this has mainly taken place in developed countries .

Most developing countries have limited or no screening , and 85 % of the global burden occurring there .

Cervical cancer nearly always involves human papillomavirus (HPV) infection . HPV is a virus with numerous strains , several of which predispose to precancerous changes in the cervical epithelium , particularly in the transformation zone , which is the most common area for cervical cancer to start . HPV vaccines , such as Gardasil and Cervarix , reduce the incidence of cervical cancer , by inoculating against the viral strains involved in cancer development .

Potentially precancerous changes in the cervix can be detected by cervical screening , using methods including a Pap smear (also called a cervical smear) , in which epithelial cells are scraped from the surface of the cervix and examined under a microscope . The colposcope , an instrument used to see a magnified view of the cervix , was invented in 1925 . The Pap smear was developed by Georgios Papanikolaou in 1928 . A LEEP procedure using a heated loop of platinum to excise a patch of cervical tissue was developed by Aurel Babes in 1927 . In some parts of the developed world including the UK , the Pap test has been superseded with liquid @-@ based cytology .

A cheap , cost @-@ effective and practical alternative in poorer countries is visual inspection with acetic acid (VIA) . Instituting and sustaining cytology @-@ based programs in these regions can be difficult , due to the need for trained personnel , equipment and facilities and difficulties in follow @-@ up . With VIA , results and treatment can be available on the same day . As a screening test , VIA is comparable to cervical cytology in accurately identifying precancerous lesions .

A result of dysplasia is usually further investigated , such as by taking a cone biopsy , which may also remove the cancerous lesion . Cervical intraepithelial neoplasia is a possible result of the biopsy , and represents dysplastic changes that may eventually progress to invasive cancer . Most cases of cervical cancer are detected in this way , without having caused any symptoms . When symptoms occur , they may include vaginal bleeding , discharge , or discomfort .

= = = Inflammation = = =

Inflammation of the cervix is referred to as cervicitis . This inflammation may be of the endocervix or ectocervix . When associated with the endocervix , it is associated with a mucous vaginal discharge and the sexually transmitted infections such as chlamydia and gonorrhoea . As many as half of pregnant women having a gonorrheal infection of the cervix are asymptomatic . Other causes include overgrowth of the commensal flora of the vagina . When associated with the ectocervix , inflammation may be caused by the herpes simplex virus . Inflammation is often investigated through directly visualising the cervix using a speculum , which may appear whiteish due to exudate , and by taking a Pap smear and examining for causal bacteria . Special tests may be used to identify particular bacteria . If the inflammation is due to a bacterium , then antibiotics may be given as treatment .

= = = Anatomical abnormalities = = =

Cervical stenosis refers to an abnormally narrow cervical canal , typically associated with trauma caused by removal of tissue for investigation or treatment of cancer , or cervical cancer itself . Diethylstilbestrol , used from 1938 to 1971 to prevent preterm labour and miscarriage , is also strongly associated with the development of cervical stenosis and other abnormalities in the daughters of the exposed women . Other abnormalities include : vaginal adenosis , in which the squamous epithelium of the ectocervix becomes columnar ; cancers such as clear cell adenocarcinomas ; cervical ridges and hoods ; and development of a cockscomb cervix appearance .

Cervical agenesis is a rare congenital condition in which the cervix completely fails to develop , often associated with the concurrent failure of the vagina to develop . Other congenital cervical abnormalities exist , often associated with abnormalities of the vagina and uterus . The cervix may be duplicated in situations such as bicornuate uterus and uterine didelphys .

Cervical polyps , which are benign overgrowths of endocervical tissue , if present , may cause

bleeding , or a benign overgrowth may be present in the endocervical canal . Cervical ectropion refers to the horizontal overgrowth of the endocervical columnar lining in a one @-@ cell @-@ thick layer over the ectocervix .

= = Other mammals = =

Female marsupials have paired uteri and cervixes . Most eutherian (placental) mammal species have a single cervix and single , bipartite or bicornuate uterus . Lagomorphs , rodents , aardvarks and hyraxes have a duplex uterus and two cervixes . Lagomorphs and rodents share many morphological characteristics and are grouped together in the clade Glires . Anteaters of the family myrmecophagidae are unusual in that they lack a defined cervix ; they are thought to have lost the characteristic rather than other mammals developing a cervix on more than one lineage .

= = Etymology and pronunciation = =

The word cervix (/ ʔsʔrvʔks /) came to English from Latin , where it means " neck " , and like its Germanic counterpart , it can refer not only to the neck [of the body] but also to an analogous narrowed part of an object . The cervix uteri (neck of the uterus) is thus the uterine cervix , but in English the word cervix used alone usually refers to it . Thus the adjective cervical may refer either to the neck (as in cervical vertebrae or cervical lymph nodes) or to the uterine cervix (as in cervical cap or cervical cancer) .

Latin cervix came from the Proto @-@ Indo @-@ European root ker- , referring to a " structure that projects " . Thus , the word cervix is linguistically related to the English word " horn " , the Persian word for " head " (sar) , the Greek word for " head " (Greek : koryphe) , and the Welsh word for " deer " (Welsh : carw) .

The cervix was documented in anatomical literature in at least the time of Hippocrates ; cervical cancer was first described more than 2 @,@ 000 years ago , with descriptions provided by both Hippocrates and Aretaeus . However , there was some variation in word sense among early writers , who used the term to refer to both the cervix and the internal uterine orifice . The first attested use of the word to refer to the cervix of the uterus was in 1702 .